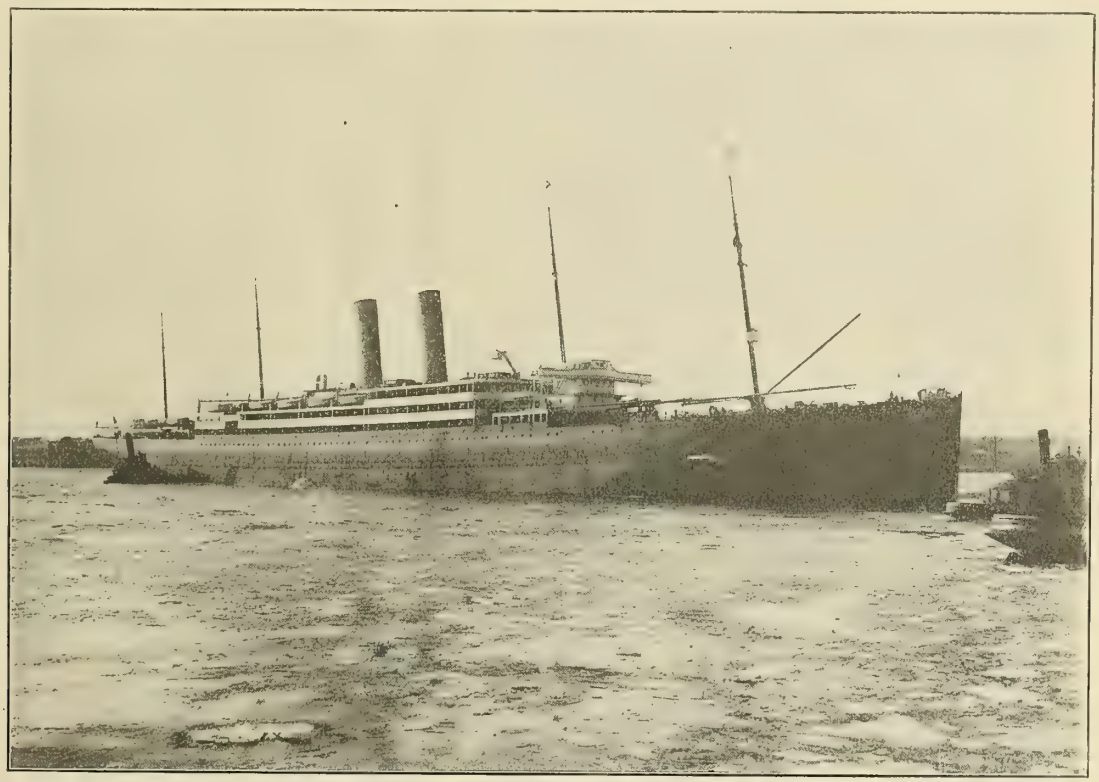
INDEXED

Marine Engineering

Vol. 8. NEW YORK, APRIL, 1903. No. 4.

NEW WHITE STAR LINE STEAMSHIP CEDRIC.

The appearance of a new large ship in the transatlantic trade is becoming of such ordinary occurrence that the *Cedric's* introduction to our harbor was looked upon with only passing interest by the general public. However, to the shipbuilder and those interested in allied trades this great ship possesses many interesting features. The steamship *Celtic,* of the White Star Line, has already been described in these pages, and her sister ship, the *Cedric,* the subject of this article, has the same external dimensions as the *Celtic,* but, by reason of structural differences, to provide increased passenger accommodations, the gross tonnage of this new ship is slightly increased.



WHITE STAR LINE STEAMSHIP CEDRIC, THE LARGEST SHIP AFLOAT.

The *Cedric* is 700 feet in length, 75 feet breadth, 49 feet 4 inches deep, with a gross tonnage of 21,000 tons and displacement of 38,200. Her general external appearance is shown in the engraving on this page. She has four masts and two funnels and a flush weather deck from stem to stern. It is on this deck that the several superstructures are erected. The most striking feature of the hull construction is the doubling of the shell plating for three strakes over practically the entire length from stem to stern. She has a complete double bottom, built on the cellular system, and above this are five complete steel decks, which we will call orlop, lower, main, upper, and spar decks. The shell plating is laid in in-and-out strakes below the main deck, and lapped at the ends; from the main deck up it is laid flush, and the three strakes between the main and upper decks are doubled.

There are nine hatches, eight of which are for cargo, besides the engine and boiler-room hatches, and these are served by from two to three winches each. The windlass is placed in the forecastle for controlling the two stockless anchors, and four capstan heads lead to the deck above. The foremast is stepped between hatches Nos. 1 and 2; the mainmast aft of the officers' bridge house, forward of hatch No. 4; the mizzen is placed at the forward end of the second cabin deck house, aft of hatch No. 5; and the spanker, between hatches Nos. 7 and 8. A large capstan is placed at the stern. The cargo booms serving these hatches are mounted on mast platforms, as shown in the illustration on page 167 of the

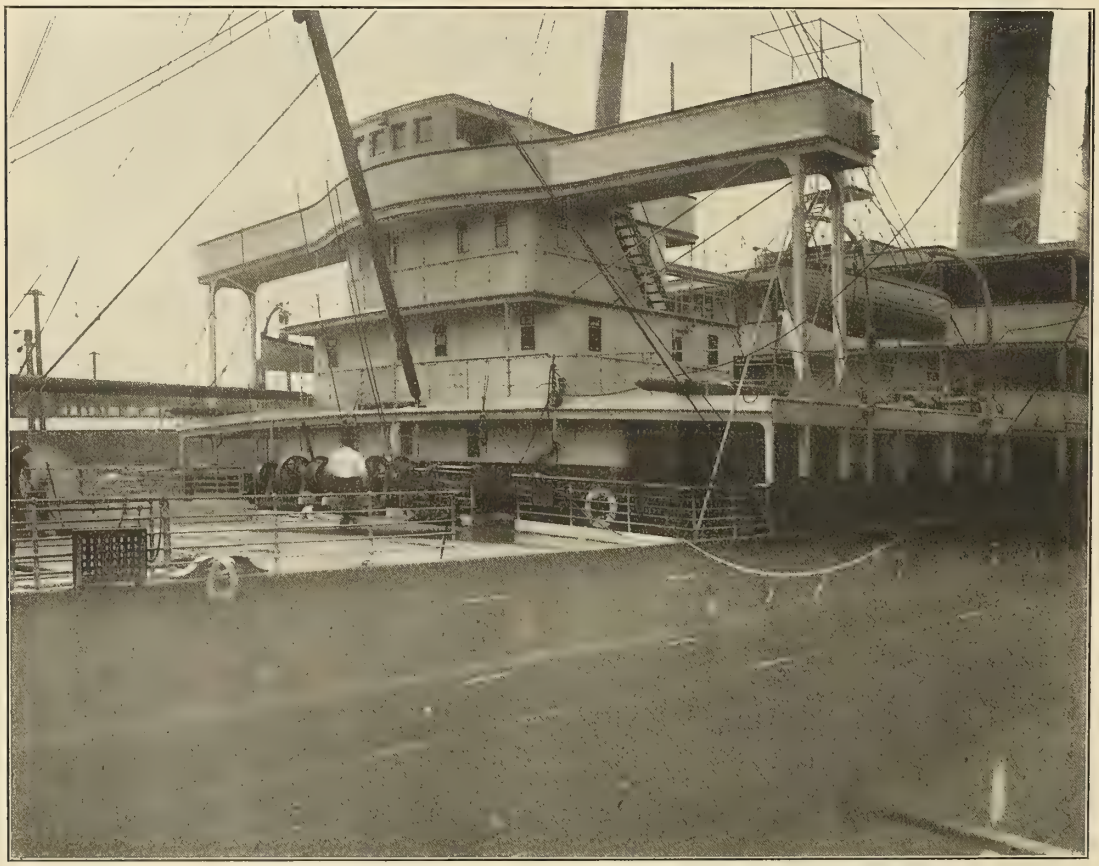
(Copyright, 1902, by Marine Engineering, Inc., New York.)

spar deck, looking forward. When at sea the booms are lowered in the rests, as shown in this engraving. The steam cargo winches each have four gipsy heads.

The particular feature of the deck houses is the officers' bridge house, just forward of the foremast. In this are located the navigating officers' quarters, the captain's rooms, and the chart room. Thus the deck department is separated from the passengers' cabins, and there is no possibility of interference in the navigation of the ship by the passengers. A flying bridge extends from the captain's bridge to the top deck of the main deck house, on which is mounted, on a high platform, the ship's compass. This can be seen in the illustration. The main house has three decks, all of which are devoted to first-cabin passenger accommodations. The after deck house is for the second cabin, and two smaller houses for the steerage.

In the matter of boat equipment the *Cedric* is probably the first liner to abandon the old-fashioned bent-arm davit in favor of an improved mechanical and infinitely more efficient system for handling the boats, the owners having fitted the ship with the Welin quadrant gear. The davit was illustrated on page 665, December issue. There are eight 30-foot lifeboats swung from this type of davit, and when the ship is at sea the boats are chocked along the edge of the deck to save promenade space. Before entering the harbor the chocks are removed and the boats swung completely inboard. The davit arms are of cast steel, revolved on a quadrant with a gear foot which sets in a track. The swinging quadrant is operated by a screw made of gun-metal, and the guide rods are sheathed with brass tubing to prevent corrosion. A special winch is provided for hoisting the boats from the water to the deck level, and two to four men suffice for swinging the boat inboard. The entire equipment has a smart and business-like appearance, and is a great step in advance over the old style of davit.

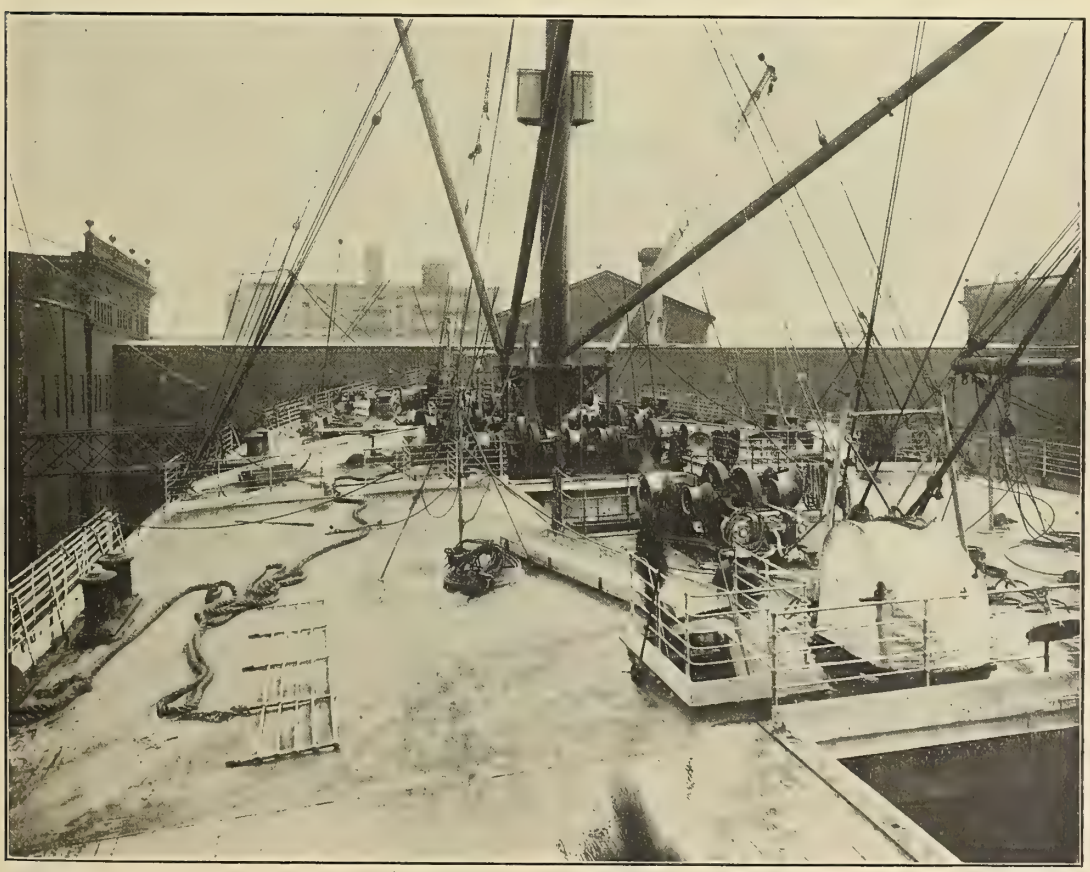
An exhaust system of ventilation is provided for the saloons by large fans placed on the boat deck. Air ducts lead from the domes and skylights, as shown in the illustration of the hurricane deck, to carry the exhausted air to the fans.



NAVIGATING BRIDGE HOUSE AND DECK VIEW, STEAMSHIP CEDRIC.

The *Cedric* will have accommodations for 350 saloon, 250 second-class, as well as about 2,000 third-class passengers, in addition to a crew of 335 men, 92 of whom will be in the engine room, making nearly 3,000 all told. The first cabins are arranged on main and upper decks and in the deck houses, as above stated. The first-class dining saloon is a handsome apartment, in gilt and white, situated on the upper deck, and extends the full width of the ship, with a seating capacity of 340 passengers. The furniture and general appointments are excellent, and there is more than the usual space between the tables. The library is a luxuriously-furnished room, and the smoking saloon is well appointed, the style being in keeping with similar rooms on other ships of this company. The state rooms and passageways are

MIDSHIP DECK HOUSE, STEAMSHIP CEDRIC, LOOKING AFT.



FORECASTLE DECK, STEAMSHIP CEDRIC, SHOWING CARGO-HANDLING APPLIANCES.

plainly finished in white paint and mahogany trimmings. One of the unique features is the placing in each room of an electric heater controlled by a switch alongside the bed. Large lavatories are provided, and the bath tubs installed are all of tin, not encased. The accommodations for the second-saloon passengers are on the upper deck and deck house, large and very well appointed for the second cabins. An unusually large number of third-class passengers can be carried aft, some in two, four, and six-berth rooms, and the rest in open berths. The beds are furnished with good spring mattresses, and the ventilation is well taken care of.

There are separate galleys and pantries for each of the three classes of passengers. In the first- and second-class quarters the floors of the main entrances and stairways are laid with patent rubber flooring, which is not only decorative, but prevents slipping or noise.

MACHINERY.

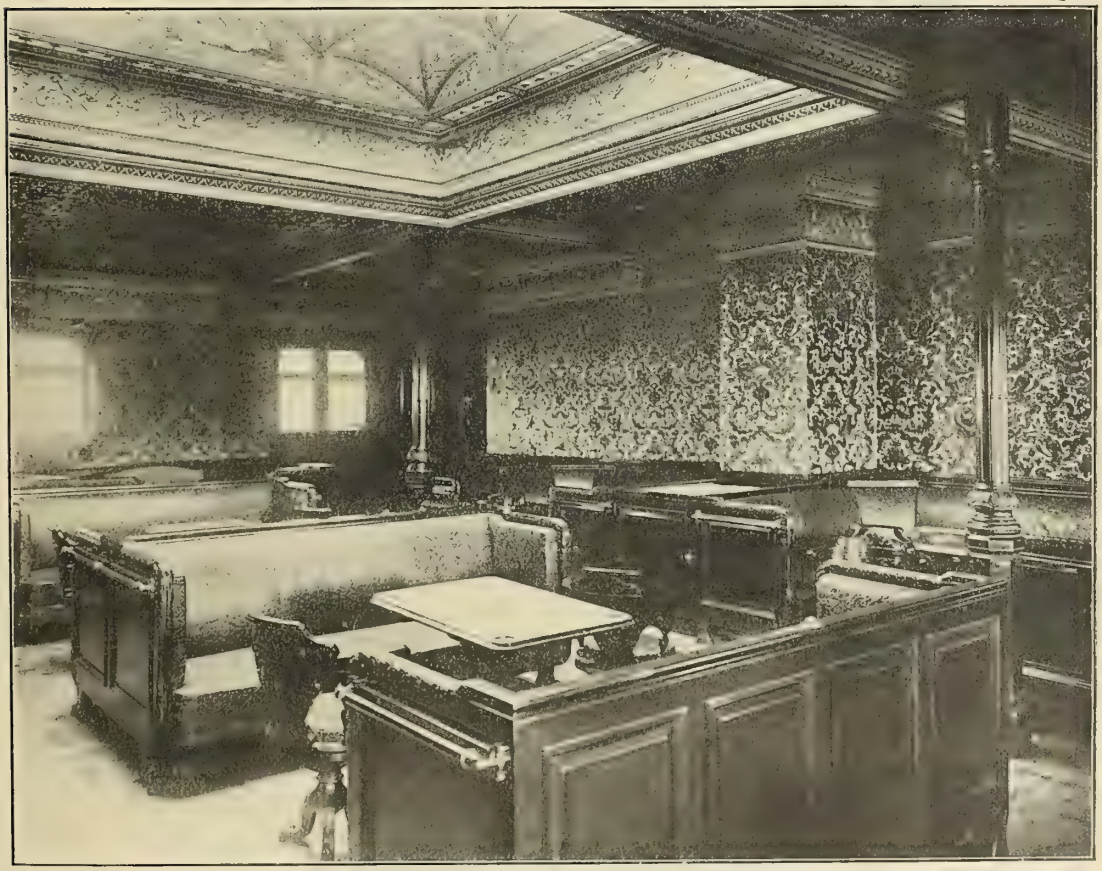
As one descends to the engine room he is struck with the roomy appearance, as the engine hatch is very large indeed, and there is much space below around the two sets of four-cylinder quadruple-expansion engines. This is for tonnage reasons; that is to say, the Board of Trade allows 33 1-3 per cent. for machinery space, and whatever of this is not used is measured as cargo space. Therefore, to reduce the tonnage and thereby save port dues, etc., all of this allotted space is devoted to machinery.

A recess on the orlop deck contains the four direct-connected Allen generating sets with compound engines. Each is of 500 amperes capacity, and, with 245 revolutions, maintains a voltage of 100 volts. The thrust shafts are located directly below this platform. Each engine works from the inside. The cylinders are supported on four cast-iron columns front and back, of the box pattern, which are braced at the top by cast-iron beams. The arrangement of the cylinders is as follows: First is the high pressure; next is the first intermediate; then comes the low pressure, and the second intermediate is at the after end. The crank webs on end cylinders have counterbalances. The cylinders are arranged in pairs; the high and first intermediate work almost opposite each other, the third and fourth at about right angles with the first pair, and the angular distance between cranks is given on the data card below. The valves of the high and first intermediate are at the ends of the engine, and those of the second intermediate and low pressure are at the center, adjoining each other. The high and first intermediate each have one piston valve; the second intermediate, two piston valves; and the low pressure, a balanced slide valve. The receiver between the high and first interme-

Name—Cedric.	Nationality—British.
Launched—Aug. 21, 1902.	Owner—White Star Line.
Type—Intermediate freight and passenger.	
Builder—Harland and Wolff.	
Length over all	700 ft.
Breadth, extreme	75 "
Depth to weather deck	49 " 4 ins.
Load displacement	38,200 tons
Launching "	14,257 "
Deadweight carrying capacity	18,400 "
Gross registered tonnage	21,000 "
Engines, type	four-cylinder quadruple
Valves	piston, except on L. P.
Cylinder diam.	33; 47 1-2, 68 1-2, 96 ins.
Stroke	63 ins.
Arrangement	H. P., 2d I. P., I. P., 1st I. P.
Sequence, H. P., 62 deg. 1st I. P., 96 deg. 2d I. P., 106 deg. I. P. 96 deg. H. P.	
Balance	Schlick-Tweedy system
Condenser	in engine casing, 2 153 tubes each
Cooling surface	9 000 sq. ft. each
Auxiliary condenser	1,160 sq. ft.
Rev. at sea	77.5
I. H. P. at sea	14,000
Thrust bearing	18 3-4 ins., 10 collars 29 1-2 ins. diam., 3 1-4 ins. thick. 7 3-4 ins. between
Shafting diam.:	
Crank,	19 1-4 ins.; pins, 20 ins. diam.
Line	by 19 1-2 ins.
Tail,	18 3-4 ins.
	19 1-2 ins., covered by 3 liners, 7 ft.

Name—Cedric.	Nationality—British.
Launched—Aug. 21, 1902.	Owner—White Star Line.
Type—Intermediate freight and passenger.	
Builder—Harland and Wolff.	
Propellers, hubs	cast steel
Blades	bronze
No. of blades	three
Diameter	20 ft.
Pitch	24 ft. 6 ins.
Developed area	99 sq. ft.
Boilers	eight double end Scotch
Diameter	15 ft. 6 ins.
Length	19 " 6 "
Plates, shell	1 9-32 ins.
Furnaces, number of	six each
Diameter, mean inside	3 ft 8 ins.
Steam pressure	210 lbs.
Draft	natural
H. S.	41,680 sq. ft.
G. S	1,008 " "
H S. ÷ I. H. P	2 98
I. H. P. ÷ G. S.	13 9
H S. ÷ G. S.	47 35

LIBRARY AND WRITING ROOM, FIRST CABIN.



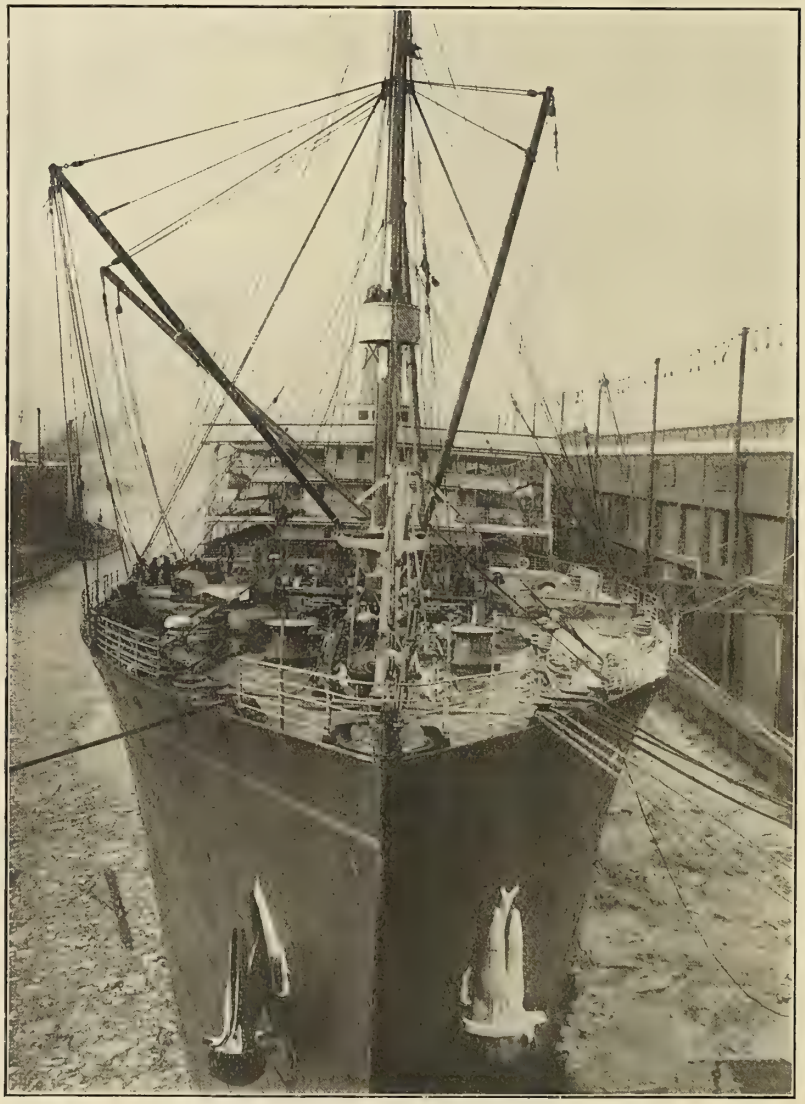
SMOKING ROOM, FIRST CABIN, STEAMSHIP CEDRIC.

diate is placed on the outboard side of the engine. The condenser is built in the back framing of the two after cylinder columns, and the air pump is direct connected to the first intermediate. The shafting is solid and the crank shaft is in three lengths with eight main bearings. The distance between centers of cylinders is approximately 10 feet 6 inches, 17 feet 6 inches, 10 feet 6 inches. The thrust shaft is of the usual horseshoe type, with ten adjustable collars. The line shaft is in seven lengths, and all couplings are fitted with nine tapered bolts. The connecting rods are of forged steel, with brass boxes at the top and bottom. The piston rods are attached to cast-steel crosshead blocks which are bolted to composition slides bearing on guides on front and back columns. The eccentric straps are of cast iron, and the rods are solid, with forged ends.

The reversing gear is of the usual Stephenson type, the reversing shaft being mounted on the inboard side of the engine, and is operated by a steam reversing piston. The turning engine is connected to No. 3 coupling.

The feed pumps are placed at the forward end of the engine room, and are of the Weir pattern. There is the usual installation of bilge, water-ballast, circulating and sanitary pumps.

There are two separate water-tight boiler rooms, each one containing four double-end six-furnace Scotch boilers, each battery with two thwartship fire rooms. Shallow wing bunkers in the engine room supply coal from the bunkers above to the after stokehole. A thwartship bunker between the boiler rooms supplies the forward end of these boilers and the after end of the forward boilers, and another thwartship bunker supplies the forward hold. A recess in the forward boiler-room bulkhead leads to the refrigerating engine room, used for refrigerating the main 'tween-deck cargo space. There are no wing coal bunkers. One to the stokehole is fitted with two hydraulic ash ejectors, but in the other the ashes must be removed by buckets hoisted up the ventilator by a cable.



BOW VIEW OF THE CEDRIC, AT HER WHARF, NEW YORK CITY.

THE THEORY OF LUBRICATION REDUCED TO PRACTICE.

BY J. K. NYE.

Oil is one of the necessary expenses of moving machinery, and in many cases its value would be a good interest on cost of the machinery it runs. It is safe to say that not one man in a thousand who deliberately squirts oil into a bearing really has any idea just why the bearing runs easier or cooler; sufficient for him that it does so, and lucky for him that an overload of oil seldom does harm. To these men friction means little or nothing, and a surface which is perfectly smooth to the eye is the best that can be made, and the little abrasive points which the microscope would show on such surfaces have no place in their minds, and consequently bear no reference to the use of the squirt can. Let any one of these men take a smooth file and press it ever so gently over a hard metal surface, it will do its work perfectly, tearing off little particles of the metal, but still leaving the surface smooth; but let them rub their hand over the surface of this metal and just the greasiness of the skin will so change its condition that the file will no longer bite, but will push over it, even with added pressure, without abrading it. This is one of the prettiest illustrations of lubrication that can be given, and carries with it every principle of friction and lubrication as fundamentally as old Watts' original machine carried with it the principles of the steam engine. The tiniest wearing surface of a watch pivot polished and finished to the highest degree and revolving in its jewel has on its surface as perfectly-developed abrasive points as the file, and from this up to the most gigantic bearing of the big marine engine the same condition exists.

Modern tools of precision have reduced this feature greatly, but even with this precision lubrication is a long way from perfection. If it were possible to standardize these imperfections a certain oil could be made the standard of certain sizes of bearings, but even with accurate tools our shops never turn out one surface just like another surface in its requirements of lubrication, either in the kind of oil or quantity to be used, and to ask the man in charge to exercise anything like the delicacy of perception necessary to cater to these microscopic variations in abrasiveness would be asking altogether too much of human nature. Thus in many cases manufacturers have found it necessary to so arrange the lubrication that it shall be automatic, and the prettiest practice of to-day is the case where excessive lubrication does no harm and where the waste is caught to be used over and over. In marine practice the severest conditions are found; the high-speed machinery, the close confines of the engine room, the high temperature, and the absolute necessity for long runs without stop, which allow no chance for examination, make anything like delicate lubrication out of the question.

The lubricants may be roughly classed under two heads: oils and greases.

The first including almost anything liquid made from mineral, animal, or vegetable.

Second, any compound of these which may be held solid or semi-solid at ordinary temperature.

Of course by far the greater proportion of oils are mineral products, known as hydrocarbons, produced from the earth. In marine practice no vegetable oil and very little animal oil is used, although some engineers still cling to the old method of pouring on lard oil; but it is safe to say that no animal oil is ever used on any steamship that could not be replaced to advantage by a mineral oil, provided a careful study of the situation were possible by the man in charge. Animal oil putrefies, or, in other words, oxidizes, under certain conditions, as every one knows, and those conditions could not be more perfect than those found in the engine room, particularly marine.

Oxidation or putrefaction means a formation of natural acid which will absolutely attack any piece of metal, especially if a minute quantity can be held in a correspondingly sized cavity which by reason of its motion has a tendency to heat; and if any engineer who reads this will stop and in his mind try to magnify the infinite number of little abrasive points and cavities which must exist, say, on a crank pin with its high speed and tendency to heat, he is then beginning the careful study of lubrication. He will then have at least a glimmering of the direful results which the formation of anything like an acid product would be to that microscopic pit, and, having conceived the damage to this tiny spot, he has but to multiply it by the tens of thousands of such little abrasive pits that must exist in even the finest turned and ground crank pin, to realize the ultimate result.

Mineral oils, being pure hydrocarbons and non-oxidizable, can never produce this result, although their very lack of oxygen gives them a certain evaporative power which requires a somewhat greater amount of oil. This very evaporative power, however, has a decided advantage in keeping the bearing cool, so that while perhaps a little more oil must be used to take up the evaporative loss, requiring a little more work for the man with the "squirt can," the results on the surface of the metal are far better. Engineers who care to, can go even further than to conceive of all these tiny abrasive points and pits, and by studying the phenomena of capillary attraction they will find themselves ultimately asking this question about these little abraded places which exist even in the finest bearing: Why do not these pits draw into themselves a little more oil than their actual volume? This is probably just what does take place. With a power infinitely weak the tendency is to separate the surfaces of the moving metal. While we realize that this separating capillary power *is* infinitely weak, let us again add our multiplying plan and multiply its tiny force by the millions of such little capillary pits that exist in the bearing. We shall find that the aggregate force which separates the metals will be enormous. Wherever two moving surfaces come together some of these little abrasive points are being constantly torn away, otherwise machinery would never wear out; but of course in some metals they are far more tenacious than in others. It has been found that two dissimilar metals, the one perhaps soft, the other hard, become far more serviceable in their wear and make easier lubrication, like a steel shafting running in a babbitted bearing, in which the hard abrasive points cut their own little paths in the softer metal. These little paths fill with the lubricating material, and, exercising their capillary forces, greatly lessen the friction, and by the very na-

ture of the softer material carry off more rapidly the generated heat. With these facts in mind it becomes evident that the higher the speed at which one metal surface is running over another the thinner the lubricating material needs to be, both for its greater ability to enter the capillary passages and more rapidly its evaporating power to remove the generated heat. Therefore the gravity, viscosity, and fire test (the latter of which indicates its evaporating qualities) which may be used in any particular bearing must be left wholly to the judgment of the man in charge of such a bearing, and it is up to him to understand and choose for the situation.

So much for bearings; when it comes to the steam cylinder we have an altogether different and far more difficult phase of lubrication. The high temperature of the steam not only changes the nature of the oil, but adds greatly to the ease with which the abrasive points and pits change their nature. Steam itself changes the chemical constitution of the lubricating material, and in the case of compounded oil, which is so largely used at this day, the very viscosity itself becomes radically changed. Those parts containing oxygen may become semi-solids or even solids, which, filling the little microscopic pits of the metal, allow no chance for the thinner fluid to flow in and exercise its capillary force. While for a long time the surface about such a solid filled pit may become brilliantly smooth to the eye, the natural decomposition which will take place rapidly in a high temperature and the presence of watery vapor will gradually deepen and deepen its tiny hole until the inside walls actually crumble away, and in time destroy the fit between the piston rings and the walls of the cylinder. Here again the engineer has a wide field for study. The varying piston speed, the wide range of temperature by reason of steam pressure, and even the quality of the iron itself, bear more strongly than is generally supposed upon the system and quality of lubrication, and it is the writer's belief that by far the safest oil for the lubrication of the steam cylinder is an absolutely straight mineral oil. In many cases the steam itself, with its own fluid capacity for capillary operation, is a perfect lubricant, and the only requirement for a more viscous substance is the small portion required to fill a certain number of large or irregular cavities which may exist beyond the power of the water to fill.

We will return a moment to the subject of bearing. We all know that to turn and perhaps grind an exquisite fit would be far too expensive in most cases, so that many bearings are indeed so loose that, even without being sensibly so, there are large spaces between them and the shaft itself. In such cases the oil will flow away from it directly by gravity, and it becomes necessary to have some substance far more viscous and with a sort of glacial movement in order that the bearing be filled at all. This is the province of the greases. Such a bearing would not heat rapidly, and at the same time the grease holds sufficient capillary power to keep the shaft fairly well suspended. It would be obvious that such a lubricant would never do for a steam cylinder.

Another interesting scientific fact some engineers may do well to study is the varying property that different liquids have for resisting disruption, some vastly more than others. A very pretty illustration of this is the old trick of rubbing the edge of a wineglass with the wetted finger. Water has very little power of resisting disruption, consequently it forms little or no film upon the smooth glass edge of the wineglass, and the little abrasive points catch and let go as the finger is moved over them in such a rapid manner that a musical note is sounded; but the slightest particle of oiliness would instantly change the condition and the finger run over without resistance. This is because the oil gathering in infinitely minute drops fills the abrasions of the surface, and, resisting disruption, lifts the finger away from the glass itself. This illustrates one of the principles of lubrication.

Oil is sold largely by brands, and almost every engineer knows how utterly helpless he becomes when placed in the hands of an oil drummer with his sample of "Everlasting Cylinder Oil" or "Everlasting Machinery Oil." "The only brand on the market which will absolutely do its work perfectly."

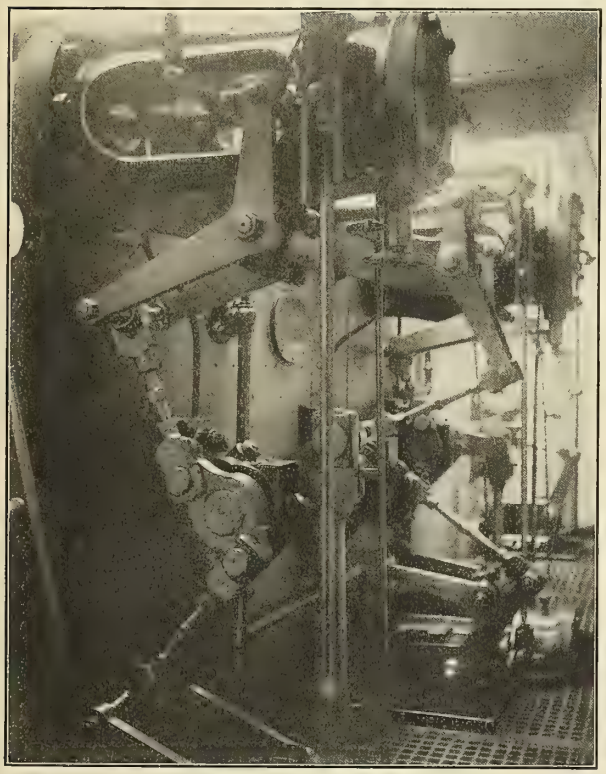
It would not be difficult for any engineer, if he were so disposed, to get from a reputable manufacturer all the information he needed regarding gravity, viscosity, and fire test of every mineral oil. If he would in his mind's eye watch the operation of the little particles of oil as they move in the cylinder or bearing, he would in time get his perception delicate enough to choose, by just this gravity, viscosity, etc., alone, what was best suited to his class and quality of machinery, and, having once attained to that knowledge, no wily drummer could thereafter offer anything but just what he knew to be the best. If the practice were universal all brands would in time disappear from the market and the oil would be sold by the above-named terms strictly by its chemical constitution.

If a steamship leaving New York, taking a supply of oil of some well-known brand, should run short at a South American port, the engineer is utterly in the hands of some dealer on replenishing his supply; but, knowing the gravity, viscosity, fire test, and other standard requisites, he can always buy the same article in Rio Janeiro that he bought in New York. There is little probability that a brand of "Everlasting Machinery Oil" would be the same in Rio Janeiro as in New York, but if an engineer knew enough to distinguish a "23 gravity, 420 fire test, 414 viscosity oil," such as the Standard Oil Company sells the world over, he could duplicate it in any part of the world.

I name this particular oil as an example; the same is true of every grade of mineral oil, from a 300 fire test up to the heaviest cylinder oil.

There are a large number of chemical compounds sold in the market to-day by their percentage of useful qualities, and in most cases this is the cause: the evils of an inferior quality show immediately, and the minds of men have become so wary that they have learned to quickly and easily distinguish a proper and improper article for their use, although they have been obliged to study and make use of instruments to be able to make their determination. Unfortunately the evils of an improper oil are a long time in developing. The keenness of perception which a man must cultivate to be able to distinguish the exact quality of an oil against the eloquence of the drummer can only be acquired by close observation and the use of instruments.

To be sure, there are many engineers who look upon the purchase of their oil as a legitimate perquisite, and this glowing eloquence of the drummer makes anything like the real commercial value of an oil hard to determine; but, given an honest, thoughtful engineer who is willing to study and learn the correct lubricating qualities of any oil for his particular use, it will be easy for him to determine the proper price for an oil, based upon the refinery price and its distance from point of production.



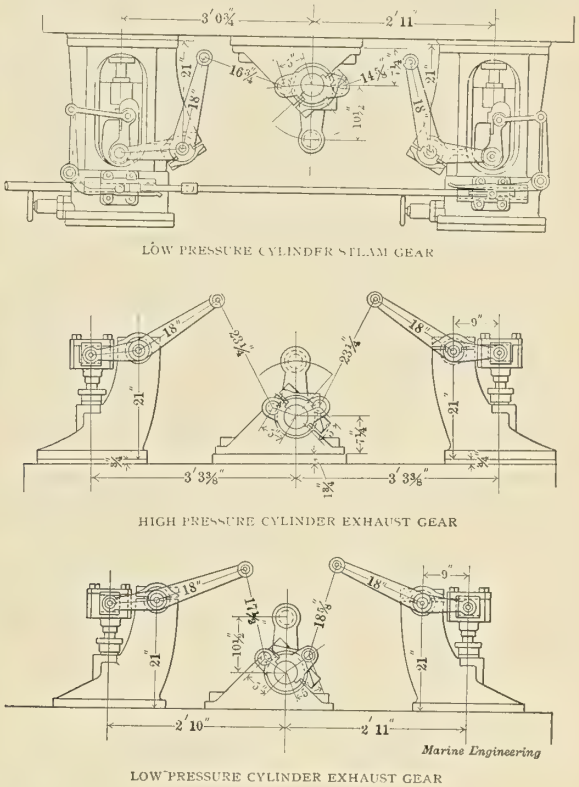
VIEW OF VALVE GEAR ON A MARINE ENGINE.

A MARINE ENGINE WITH CORLISS VALVE MECHANISM.

BY WILLIAM H. CRAWFORD, JR.

While we would naturally suppose that the highest type of marine engine development is to be found in the new ships that are being turned out almost weekly from the shipyards at home and abroad, there is at least one marine engine, of considerable age, that should not be overlooked; it is the compound engine built and placed in the steamer *City of Puebla* by the Wm. Cramp and Sons' Ship and Engine Building Company, of Philadelphia. Although it has since passed into apparent obscurity, the record of its performance is well worth investigation. The *City of Puebla* is now running in the service of the Pacific Coast Steamship Company between San Francisco and Seattle, by way of Victoria, B. C., touching also at various Puget sound ports. Prior to her appearance on the Pacific coast some years ago, this steamer was engaged in the New York-Havana service, where she was put into commission in the year 1882. After over twenty-one years of continuous running, with less than the average number of layups for this length of time, the engines in the *City of Puebla* are to-day able to hold their own with the best modern triple-expansion engine that has come to our notice, even as regards economy.

While the ship was building at the Cramp shipyard the design of her engines, a peculiar combination of gridiron valves with dashpots, and Corliss actuating mechanism, was worked out and patented by Messrs. R. W. Peck, James Younger, and Christian Hoehle. The engine has cylinders 43 inches in diameter high pressure and 86 inches low pressure, by 60 inches stroke,



DETAILS OF VALVE GEAR.

developing 3,571 H. P. at a maximum boiler pressure of 100 pounds. (See indicator cards marked *A* and *B*.)

The air, feed, circulating, and bilge pumps are independent, working from an auxiliary line of shafting mounted on the main engine frame, as will be seen by reference to drawing of engine shown herewith, and are driven by two vertical engines with steam cylinders 18 inches diameter by 24 inches stroke. Pump cylinders are all 5 1-4 inches diameter by 24 inches stroke.

By referring to the accompanying photograph of the valve rigging and dashpot arrangement on the main engines we can get a good idea of the unusual appearance presented in this engine room, which is probably one of the most interesting to be seen afloat to-day.

All valve setting and adjustments must be made while the engine is in motion; and, with proper care, almost perfect indicator cards can be obtained. The record for economy was made some time ago when A. H. Kress was chief engineer, the engine developing one horse power per hour on 1 3-4 pounds of coal.

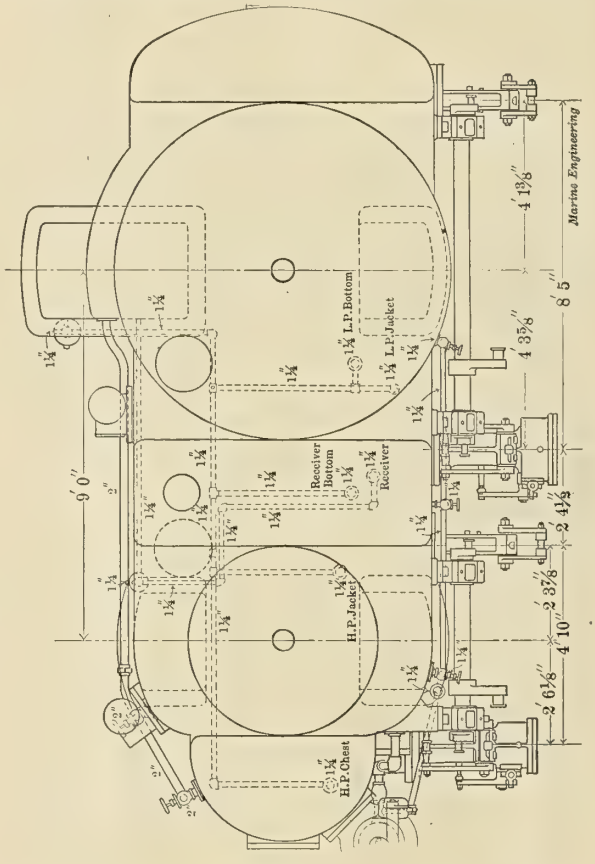
At a speed of from 70 to 71 turns per minute this engine will drive the ship 14 knots per hour, and the maximum number of revolutions that has ever been

attained, as far as record goes, is 82 per minute, which gives a piston speed of 820 feet. Considering the size of this engine and its complication of parts, such a speed is quite remarkable. By referring to indicator cards *A* and *B* it will be seen that the balance of power is very good, on this occasion the high-pressure and the low-pressure cylinders being balanced to within 41 horse power of each other. The high-pressure was developing 1,765 of the total of 3,571, and the low-pressure 1,806 horse power. It should be added, however, that this is not the best that has been accomplished in balancing this engine. At one time the two cylinders were worked up so close to each other that no figure showed in the third decimal place, which was to all intents and purposes a perfect balance.

The main steam pipe is 12 1-2 inches in diameter, with two 9-inch branches and one branch 6 inches in diameter. One reason why such excellent results are attainable is because of the small steam clearances at both top and bottom positions. There are, as will be seen, two steam and two exhaust valves to each cylinder, making a total of eight valves. Careful adjustment is always required, as a difference of 1-32 inch on the high-pressure steam valve (and there are about 14 joints and connections from the main shaft to the valve stem in each case) will make a very appreciable difference in the steam consumption. This is easily understood by referring to sketch of the high-pressure valve and its seat. Here are eight openings about 15 inches wide; thus a travel of 1-32 inch would correspond to an opening of almost 4 square inches.

It is evident that a man must live right with this engine in order to get anything out of it, and eternal vigilance is the price of success in this case, if nowhere else. So far there have been but five men who have handled this engine in all the twenty-one years of service: Messrs. Bloxome, A. H. Kress, P. L. Plaskett, Frederick Nixon, and Thomas W. Spencer, in the order given. The indicator card is an indispensable ally.

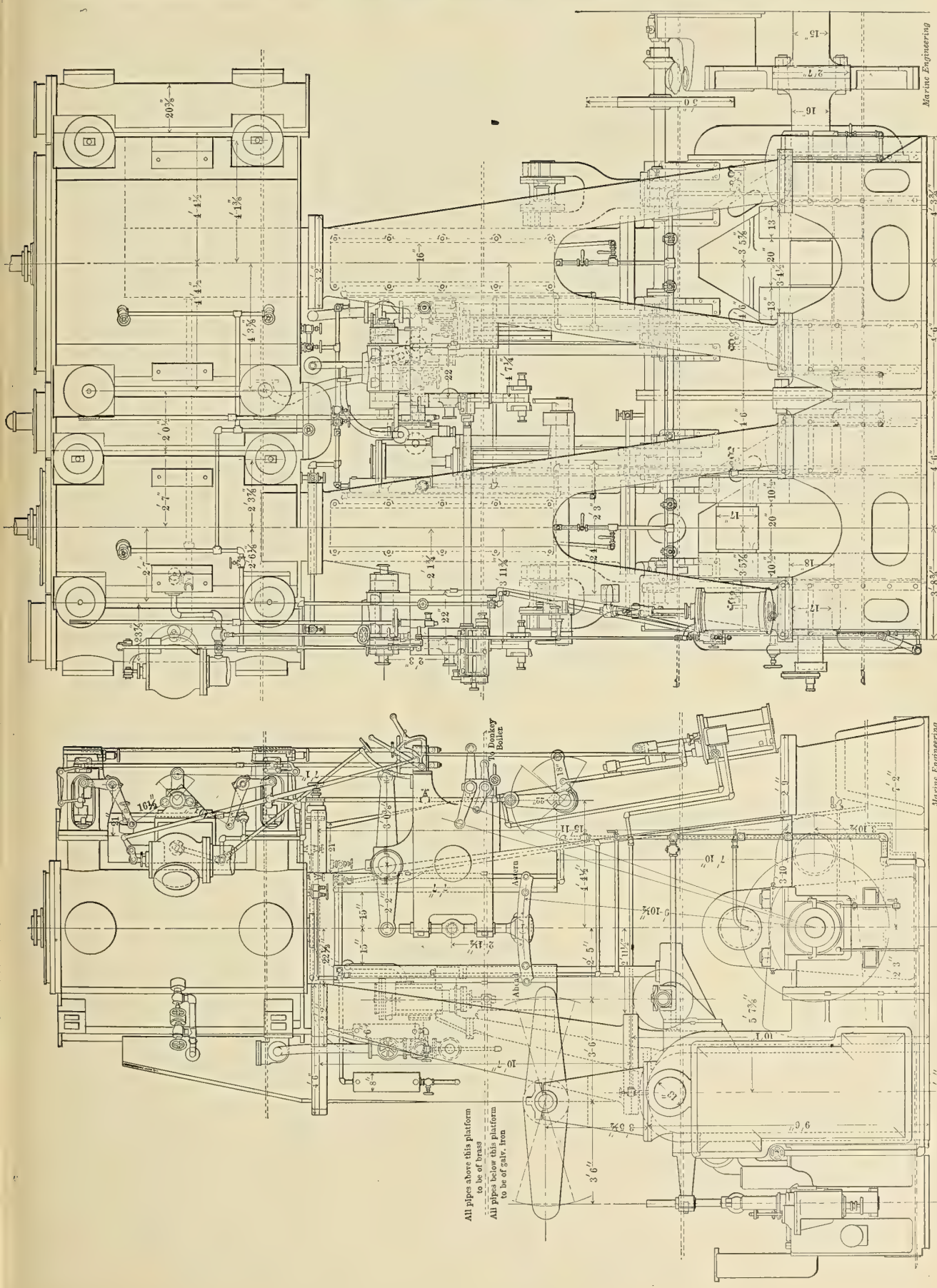
On one occasion—to be accurate, August 9, 1902, at 6.15 P.M.—while the chief was sitting in his room, he heard the relief valve on the low-pressure receiver let go. This valve was set to blow off at 12 pounds, and, knowing that something unusual had happened, he got to the throttle as quickly as possible and closed it down, almost shut. The engine continued to turn over and he took an indicator card from the high-pressure cylinder, with the result as shown on card carked *C*. This gave evidence of a break in either the high-pressure steam or exhaust valve, which would allow steam at boiler pressure to blow through to the low-pressure receiver. On stopping the engine and investigating, it was found that the high-pressure exhaust valve and valve seat on bottom end were carried away, breaking, as shown by sketch. After clearing up the wreckage and disconnecting that valve stem, also disconnecting and closing the steam valve on the same end of the high-pressure cylinder, the engine was started up again, taking steam on the top end of the high-pressure cylinder only. The by-pass to the low-pressure receiver was opened just enough to make up for loss of steam, and the engine started again, after a delay of but 1 hour and 33 minutes. With cut-off at 26 inches, 100 pounds of steam on boilers, and engine making 61 revolutions per minute, the ship logged 12 knots per hour, the high-pressure cylinder, with the one end only, developing 777 horse power. In this condition the boat was able to continue on her voyage, making the regular run, calling at five ports, and handling almost as well as though nothing had happened. There are recorded



but two previous breaks of this character, one when the low-pressure exhaust valves were broken, and the other when one of the high-pressure steam valves broke. Aside from such minor troubles the twenty-one years of service of this engine is a record cleaner than it is usual to find where a ship has been driven so hard and so continuously.

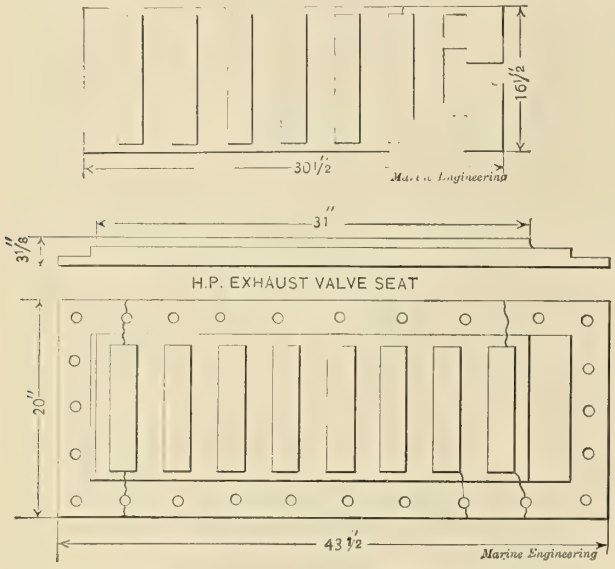
It is a fact worthy of note that *no radical changes have been made* in the engines in this ship, regardless of their originality and the bold manner in which the designers laid aside all precedent. In fact, the most important change has been in the construction of the cutter bars. It is to be assumed that these will wear considerably and must be replaced from time to time. Originally they were simply made of blocks of steel tap-bolted down to the valve-stem crosshead. Now, by a gradual process of evolution, they are made to be the facing for a yoke, which is in turn fastened over the place where the original cutter blocks were located. In this manner it is possible to change the cutters without stopping the engine. The wearing face of the present cutters is 11-16 inch by 3 15-16 inches, and they are made of crescent steel.

It would seem as though this escapement feature of the valve motion with attendant wear on cutters would


Marine Engineering
To Donkey Boiler
Astern
Ahead
All pipes above this platform to be of brass
All pipes below this platform to be of galv. iron

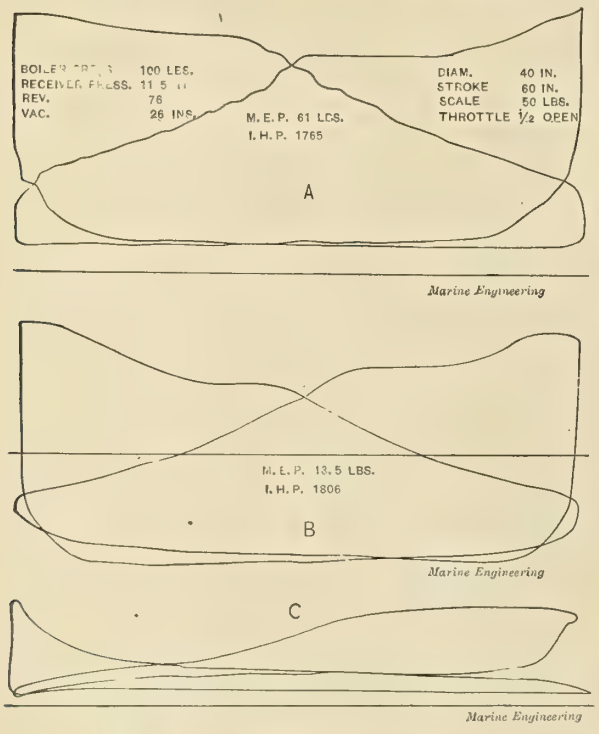
COMPOUND ENGINE WITH CORLISS VALVE GEAR ON STEAMSHIP CITY OF PUEBLA, BUILT BY THE WILLIAM CRAMP AND SONS' SHIP AND ENGINE BUILDING COMPANY.

be a weak point in the engine, but it does not seem to interfere with making long-sustained runs. During the Spanish war the *City of Puebla* was running as a transport and on her last trip home from Manila she



GRIDIRON VALVE AND VALVE SEAT.

ran from Nagasaki, Japan, to San Francisco, over 5,000 miles, without stopping once for any cause whatever, making the run in a little over sixteen days. The



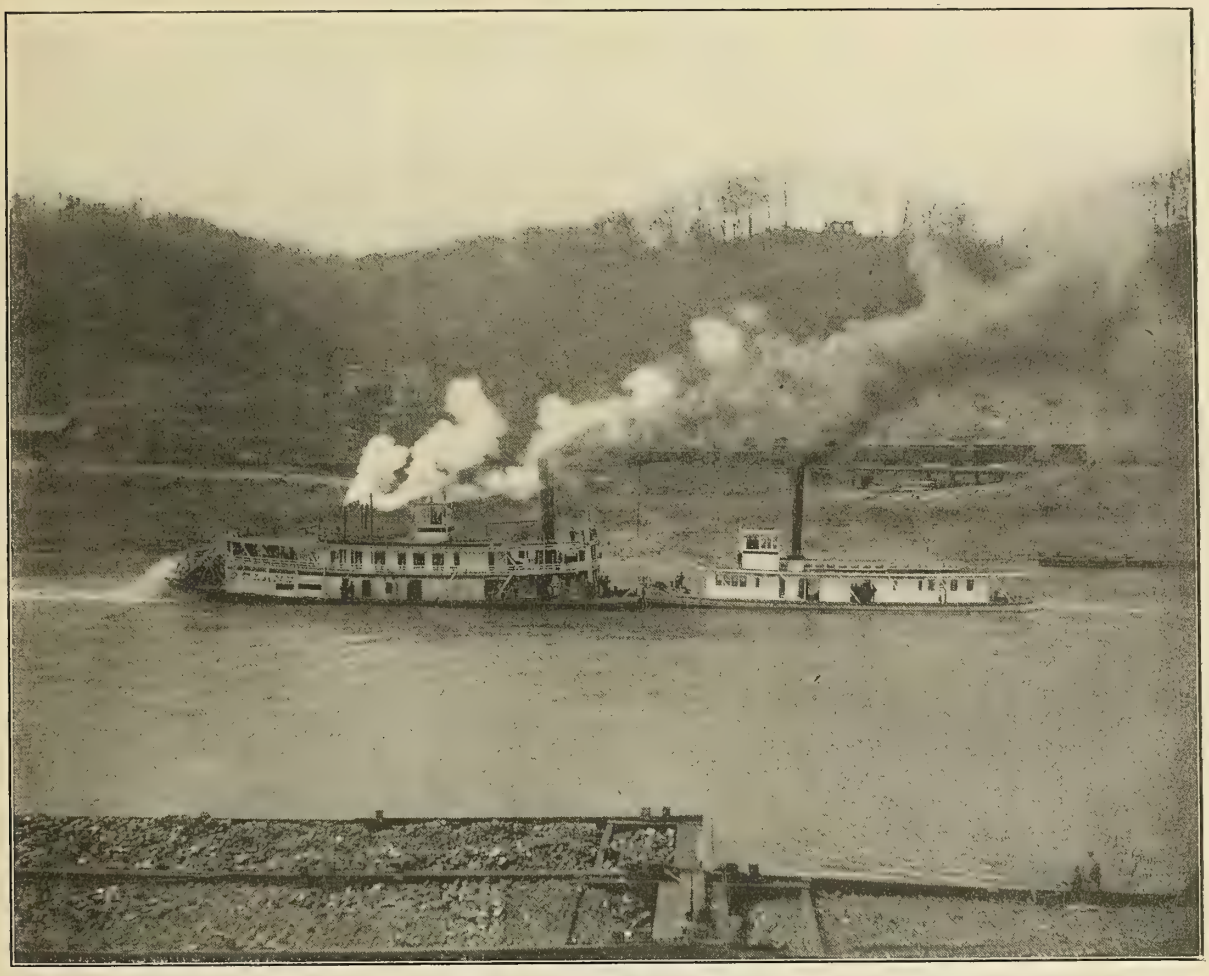
HIGH- AND LOW-PRESSURE AND FREAK CARDS.

City of Puebla as a record breaker was prominent in her day while in the New York-Havana service, and even now holds the record from Victoria, B. C., to San Francisco, having covered the distance in 48 hours and 20 minutes, or at the rate of 15.75 knots.

Name—City of Puebla.	**Nationality**—American.	**Type**—Coasting Steamer.	
Launched—1882.	**Builder**—Wm. Cramp and Sons.	**Owner**—Pacific Coast S. S. Company.	
Length over all	320 ft. 6 ins.	Steam pressure at receiver	11 1-2 lbs.
Beam	38 " 6 "	Vacuum	26 ins.
Depth	26 " 3 "	Mean effective pressure, high	61 lbs.
Load draft	20 " 6 "	" " low	13.5 "
Corresponding displacement	4,422 tons	Propeller	diam. 16 ft.; pitch, 23 ft.
Deadweight carrying capacity	2,500 "	**Boilers**, number of	four single-end Scotch
Engines, type	compound	Diameter	15 ft.
Cylinder diam	43 and 86 ins.	Length	12 " 9 ins.
Stroke	60 "	**Furnaces**, number of	four each
Valves	Corliss, with dashpots and gridiron valves	Diameter	41 ins.
		G. S., total	320 sq. ft.
Number of revolutions	76	H. S., total	9,040 " "
I. H. P.	3,571	Feed pumps	14, 8 1-4x10 in.; 9, 5 1-4x10 in.
Steam pressure at engine	100 lbs.	Generator	30 K. W.

Department of Commerce.

By act of Congress a new department has been made in the administrative branch of the government—Department of Commerce and Labor, with Mr. George B. Cortelyou appointed secretary. The following branches of the Department of the Treasury have been transferred to the jurisdiction of this new department: Lighthouse Board, Lighthouse Establishment, Steamboat Inspection Service, Bureau of Navigation, U. S Shipping Commissioners, National Bureau of Standards, Coast and Geodetic Survey, the several immigration bureaus, and Bureau of Statistics. From the Department of the Interior, the Fish Commission and the office of Commissioner of Fish and Fisheries have been transferred to the above-mentioned new department. The Bureau of Foreign Commerce is transferred from the State Department and consolidated with the Bureau of Statistics, which was formerly in the Treasury Department. The two new bureaus formed in the Department of Commerce are those of Manufacture and Corporations, the first of which shall be to foster, promote, and develop the various manufacturing interests in the United States, and their markets for the same at home and abroad. It shall be the business of the secretary of the second-named bureau to make an investigation into the organization and the conduct of business of any corporation.



PUSHING TEST OF TWO KANAWHA RIVER STEAMBOATS; THE NEW TYPE AGAINST THE OLD.

Most Unique Test of River Steamboats.

There are many ways of making tests of steam vessels with steam-engine indicators, thermometers, water meters, pyrometers, patent logs, etc., but the most unique and practical test of towboats that has come to our notice is that of the stern-wheel steamer *D. T. Lane* and the twin-screw towboat *James Rumsey,* which was made in the Kanawha river, opposite Charleston, West Virginia, on March 7.

The Ward Engineering Company, Charleston, has just completed for the government a new type of towboat, christened the *James Rumsey.* The vessel is so entirely different from all other craft on the river that steam boat men felt confident that she would be a failure. The stern wheel has been the feature of Western river steamboats ever since steam was first used on these waters and very little change has been made. So, when the *Rumsey* appeared with a new type of engines and without the stern wheel, her ultimate failure was confidently predicted. She has two sets of quadruple-expansion engines with cylinders 7, 10, 14, and 20 inches in diameter by 12 inches stroke, and is supplied with steam by a Ward boiler.

The hull is 120 feet long, 22 feet beam, 4 feet 6 inches deep, and has a mean draft of 28 inches. She was found to give most excellent results in towing and swinging barges on the river, but her superiority to the old type was not recognized until the test above mentioned.

The *Lane* stopped on her way down the river with a large tow, moored the barges to the shore, and stood out in midstream to await her small antagonist. The latter came out to meet her and the bows of the two vessels were lashed together as shown in the engraving, as it had been previously decided to make a pushing and pulling contest.

In the first contest the *Lane* was on the upstream side and had the current and wind in her favor. The engines on both vessels were started at the same moment and run at full speed ahead. Gradually the larger boat pushed her small, impudent foe downstream a few hundred feet, but at a speed not as fast as the current. Then the relative position of the two contesting vessels was changed, the *Rumsey* being on the upstream side, and the test was repeated, this time the *Rumsey* driving her antagonist before her at a greater speed than she had herself been pushed downstream. It was, however, in the pulling contest that the smaller craft demonstrated her superiority in a still greater manner. When the engines of the two vessels were reversed, the *Rumsey* pulled the larger vessel at a fair speed.

It is seldom that we are treated to such a comparison of the old and the new as is presented in the accompany-

ing engraving; the old vessel with her non-condensing engines driving a ponderous stern wheel, with steam supplied by two long tubular boilers, and when running at full power the exhaust making a noise like a locomotive and the stern wheel piling up a column of water—in fact, the entire appearance being one of terrific strain. On the other hand is the little modern vessel with a twin-screw condensing engine, the steam supplied by a water tube boiler, and the only evidence of her running being a slight ripple of water at the stern, and the only noise that due to running high-speed engines.

It takes no prophet to foresee that the old type will be eventually displaced by the new as surely as the *Lane* was pushed away by the little *Rumsey*.

NEW TYPE OF RIVER STEAMBOAT.

New Ships Authorized by Congress.

Although the fifty-seventh Congress, which adjourned on March 4, failed to enact the ship subsidy bill, a measure that would undoubtedly have given a great impetus to shipbuilding in this country, it will be seen from the following that our national legislature was quite liberal in its provisions for new vessels for government use. Ships of all sizes were provided for, and naturally the Navy secured the lion's share. The following extracts are taken from the wording of the appropriation bills as finally passed by the Senate and House of Representatives and approved by the President:

"That for the purpose of further increasing the naval establishment of the United States, the President is hereby authorized to have constructed, by contract or in navy yards, as hereinafter provided, three first-class battleships carrying the heaviest armor and most powerful ordnance for vessels of their class upon a trial displacement of not more than 16,000 tons, and to have the highest practicable speed and great radius of action, and to cost, exclusive of armor and armament, not exceeding $4,212,000 each; two first-class battleships, carrying the heaviest armor and most powerful ordnance for vessels of their class, upon a trial displacement of not more than 13,000 tons, and to have the highest practicable speed and great radius of action, and to cost, exclusive of armor and armament, not exceeding $3,500,000 each; two steel ships, to be used in training landsmen and apprentices, to be propelled by sail, and to cost, exclusive of armament, not exceeding $370,000 each; one wooden brig, to be used for training landsmen and apprentices at stations, to be propelled by sail, and to cost, exclusive of armament, not exceeding $50,000.

"And the contract for the construction of each of said vessels shall be awarded by the Secretary of the Navy to the lowest best responsible bidder, having in view the best results and most expeditious delivery; and in the construction of all of said vessels the provisions of the act of August 3, 1886, entitled 'An act to increase the naval establishment,' as to materials for said vessels, their engines, boilers, and machinery, the contracts under which they are built, the notice of any proposals for the same, the plans, drawings, specifications therefor, and the method of executing said contracts, shall be observed and followed, and, subject to the provisions of this act, all said vessels shall be built in compliance with the terms of said act, and in all their parts shall be of domestic machinery; and the steel material shall be of domestic manufacture, and of the quality and characteristics best adapted to the various purposes for which it may be used, in accordance with specifications approved by the Secretary of the Navy; and not more than two of the five battleships provided for in this act shall be built by one contracting party; *Provided further*, That the Secretary of the Navy may build any or all of the vessels herein authorized in such navy yards as he may designate, and shall build any of the vessels herein authorized in such navy yards as he may designate, should it reasonably appear that the persons, firms, or corporations, or the agents thereof, bidding for the construction of any of said vessels, have entered into any combination, agreement, or understanding, the effect, object, or purpose of which is to deprive the government of fair, open, and unrestricted competition in letting contracts for construction of any of said vessels."

This large tonnage is the result of a compromise between the naval bills of the Senate and House of Representatives. The Senate bill called for four 13,000-ton ships and the House bill for two 16,000-ton battleships and one armored cruiser. The Navy Department favored the ships of larger tonnage. For a time it appeared that no compromise could be reached by the conferees of the two legislative bodies; but on the 4th of March the bill as above quoted was passed.

The 16,000-ton battleships will probably be similar to the *Connecticut* and *Louisiana*, now under construction at the Brooklyn Navy Yard and at Newport News. There are no American battleships, built or building, having a displacement of 13,000 tons; the nearest approach to this displacement is found in the vessels of the *Maine* class, which have each a displacement of 12,500 tons.

The conferees in charge of the naval appropriation bill greatly enlarged the authority of the Secretary of the Navy in relation to the construction of war vessels in the navy yards, as will be seen by careful reading of the second clause above quoted. The broad authority of the Secretary to place $20,000,000 worth of new work in the navy yards will exert a powerful leverage in securing low bids from contractors.

The other vessels authorized are as follows:

$90,000 for relief light vessel for the third lighthouse district.

$90,000 for Five Fathom Bank light vessel, New York.

$110,000 for the construction or purchase of a steel twin-screw ferryboat for Ellis Island.

$110,000 for a new steamer for the Coast and Geodetic Survey.

It will thus be seen that 22 new vessels of various sizes and types have been authorized at an aggregate cost of $21,468,000.

In addition to the new vessels the following repairs were specifically authorized:

$10,000 for rebuilding the Coast Survey steamer *Cosmos.*

$28,000 for repairs to the Fish Commission steamer

NEW STEEL TOWBOAT BAHAL, BUILT BY MORAN BROTHERS COMPANY, SEATTLE, WASH.

$90,000 for Cape Lookout Shoals light vessel, North Carolina.

$90,000 for Heald Bank light vessel, Texas.

$30,000 for relief light vessel for the ninth and eleventh lighthouse districts.

$75,000 for tender for St. Mary's river, Michigan.

$90,000 for Blunt's Reef light vessel, Pacific ocean off Cape Mendocino, California.

$20,000 for completion of revenue cutter for service at Philadelphia. (Original appropriation $50,000.)

$200,000 for a revenue cutter for the coast of Maine.

$45,000 for the purchase or construction of a steam tug in use in New York harbor in the prevention of obstructive and injurious deposits therein.

$2,000 for two launches for use of the fish-cultural stations at Gloucester, Mass., and Battery Island, Md.

Albatross, including electric-light plant and a new steam cutter.

For overhauling and repairing tug *Lamont,* $5,000.

Two New Towboats.

Two steel towboats have recently been completed at the works of Moran Brothers Company, Seattle, Wash., and one of these is shown in an engraving. The vessels are similar in all respects and the principal dimensions are: Length, 90 feet; breadth, 19 feet; depth, 11 feet 5 inches; and the tonnage about 130 tons. Each vessel is driven by a compound engine, the cylinders being 13 and 30 inches diameter with a stroke of 24 inches. A Scotch boiler 11 feet diameter and 11 feet long, working under a pressure of 160 pounds, supplies the steam.

THE NAUTICAL PREPARATORY SCHOOL AND THE SHIP YOUNG AMERICA.

If one can imagine a well-equipped preparatory school, completely furnished dormitory, library, gymnasium, museum, laboratory, and an efficient corps of instructors, placed upon a big ship, and, with the pupils. taken round to the various countries of the world, he would form a very good idea of the Nautical Preparatory School of Providence, R. I. The purpose is to take young men and prepare them while afloat, visiting the principal countries of the world, for college or a business life. The students will be given a combination of theoretical schooling, practical training, and observation with world-wide travel on board a large steel full-rigged ship, instead of within the four walls of a building on shore. The course of study will comprise those usual in preparatory schools, the work being conducted by twenty-five professors and instructors. The number of pupils will be limited to two hundred and fifty.

Protracted cruises over many seas, visits to all lands, and contact with a great variety of people and customs, give unequaled opportunities for special studies, such as commerce and economics, science and natural history, that it would be impossible to obtain if ashore.

The *Young America,* the name to be given to the ship, will be a full-rigged steel sailing vessel with auxiliary steam power of modern type of construction. The vessel has the old sailing frigate divisions of spar deck, main or school deck, berth deck, orlop deck, and hold. A double bottom is fitted and the hull will be further subdivided into five water-tight compartments to insure safety and stability. All the comforts that are possible will be provided, and special attention has been paid to the question of safety devices and ventilation, pure water, and wholesome food. The ship will be commanded by a United States naval officer detailed for that service, and the other officers will, as far as practicable, be graduates of the United States Naval Academy. The course is also planned to prepare men for the Annapolis and West Point Academies.

The complete four years' course will include cruises to all of the principal countries in the world, and the calendar is so arranged that each cruise will be in a temperate climate and along the most approved routes for the avoidance of stormy weather. Students may be enrolled for from one to four years, while the term comprises nine months, from September to June. Opportunities will be given for going ashore and visiting the cities and points of interest along the route. Instruction will also be given in navigation and steam engineering. The school is planned on strictly naval lines, the cadets being formed into companies, and the companies divided into sections to be under the personal supervision of the professors. Cadet officers will be appointed after the first month on the basis of merit in studies and deportment; the first month they will be appointed by lot. The religious and physical training will be properly cared for, and the health of those on board will be under the charge of a regular physician. It is not the intention of those who have the Nautical Preparatory School under their direction that the course should train boys for sea service. Its object is to supplement a first-class preparatory education with world-wide travel and such knowledge of nautical matters as will aid them should they in after life be engaged in any enterprise in which ships and commerce are involved. The cadets are not to take part in the working of the ship, except for the purpose of drill, discipline, and gymnastic exercises.

Among the endorsers of this project are men throughout the country most prominent in all walks of life. The officers of the company are all of the United States Navy, and the Board of Directors and Visitors well-known throughout the country.

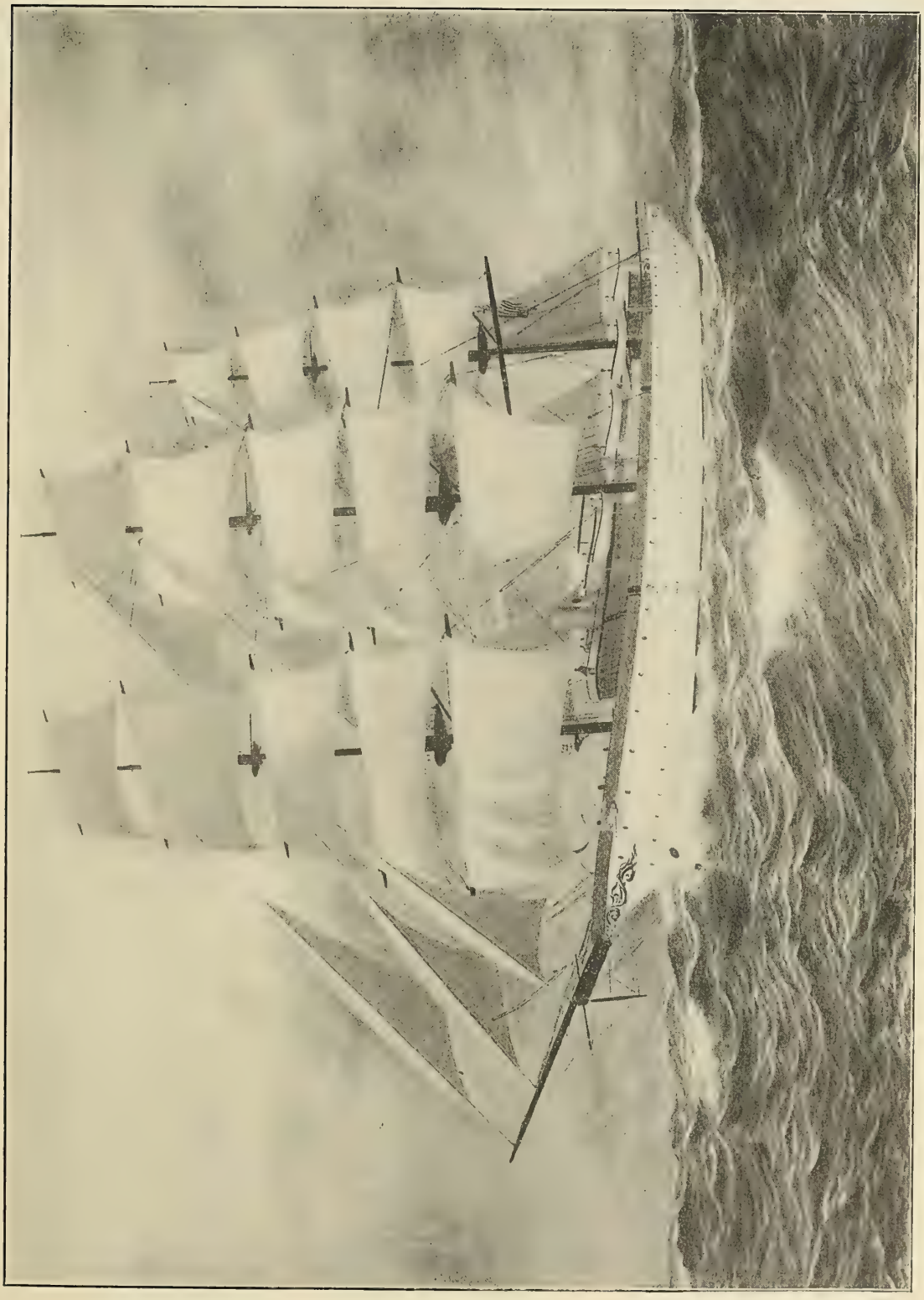
GENERAL ARRANGEMENT.

The arrangement has been carefully laid out and is shown in the accompanying deck plans. There are two deck houses on the spar deck, the forward one containing accommodations for the quartermaster, donkey boiler, drawing rooms, and a large music and recreation room, from which a stairway leads to the school deck below. A chart house and officers' companionway are in the after deck house. On the school deck, at the bow, are the crew's lavatory, store rooms, cadets' lavatory, and recreation space. On either side of the latter are the cadets' state rooms, professors' rooms, and a museum, and abaft it is the main berthing and messing space for the cadets. Further aft are the officers' rooms, with what might be called the ward room and a sick bay on the port side.

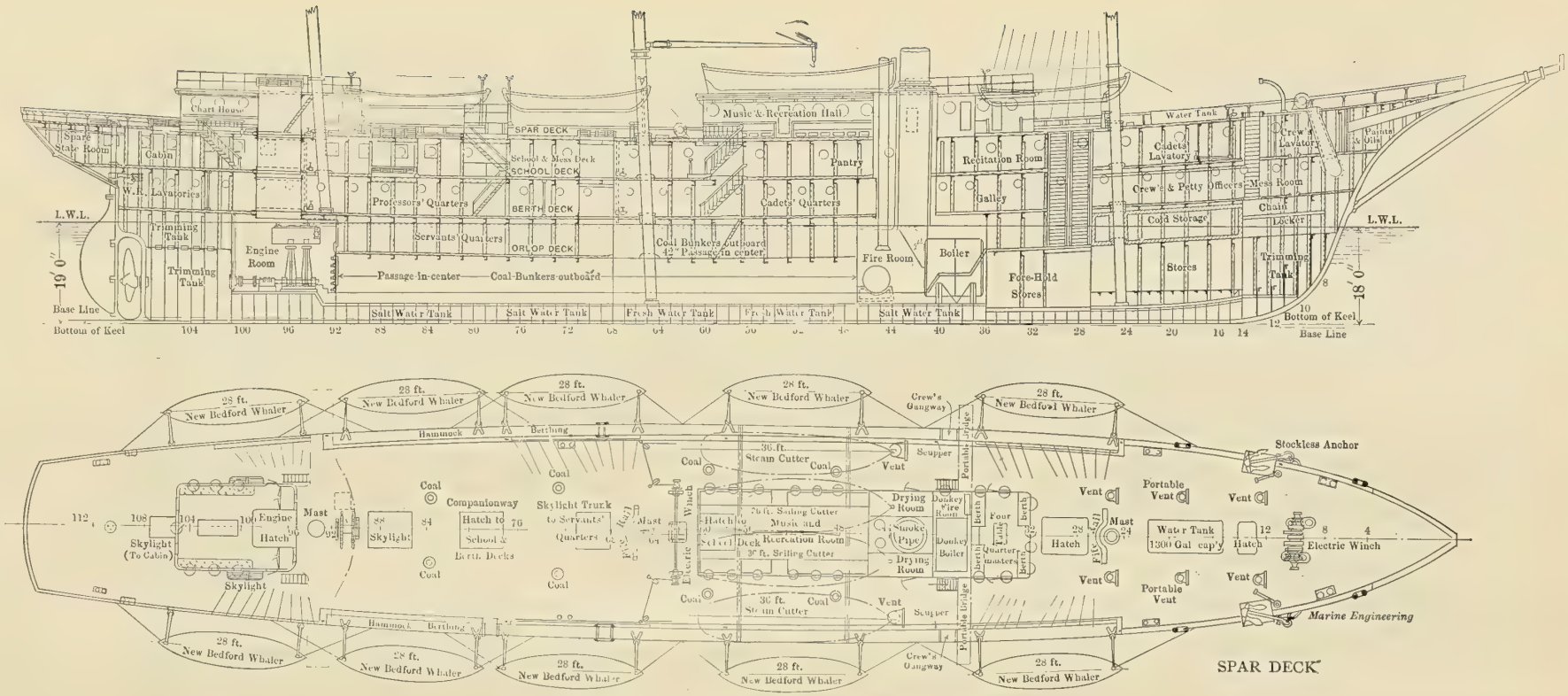
Descending to the berth deck one finds the forward end allotted to the crew and petty officers' rooms; following aft come the laundry, galleys, refrigerator, etc. Amidships is the remaining berth space for the cadets, and in the after end of the ship are placed the professors' quarters, with lavatories at the stern. On the orlop deck will be found a large cold-storage space after the chain locker, and then comes the auxiliary engine room, containing dynamos, refrigerating machinery, and pumps. The boilers are in the next water-tight compartment and also the evaporators. The coal is carried in two large bunkers amidships, and a water-tight alleyway leads from the boiler room through the coal bunkers on the midship line to the large space allotted to the servants, and it is through this alley that the steam pipe is led to the main engine, which is located at the stern. By this arrangement of machinery the ship will be on an even keel if the bunkers are full or empty. As the main engine is expected to be running only occasionally, the loss due on the condensation in the long steam pipe will not be great.

HULL CONSTRUCTION.

Now, turning our attention to the construction of the *Young America,* she is built under the U. S. Standard Registry of Shipping, and classed A1 twenty years. The vessel was designed and is under the supervision of Mr. William E. Winant, of Washington, D. C., and is being built by the Perth Amboy Shipbuilding Company, of Perth Amboy, N. J. The specifications call for a steel ship complete in every particular; the workmanship and material are of the highest class. The scantlings are given on the accompanying midship section, where it will be seen that she is to be of the flat-plate keel type, with vertical keel plate and keelsons. The stem and stern posts are of bar iron



STEEL AUXILIARY FULL-RIGGED SHIP YOUNG AMERICA, BUILDING FOR THE NAUTICAL PREPARATORY SCHOOL OF PROVIDENCE, R. I.



INBOARD PROFILE AND SPAR-DECK PLAN OF THE YOUNG AMERICA.

molded and sided, as shown. The rudder is also of wrought iron, of the double-plate type, filled with white pine, and payed with pitch and tar.

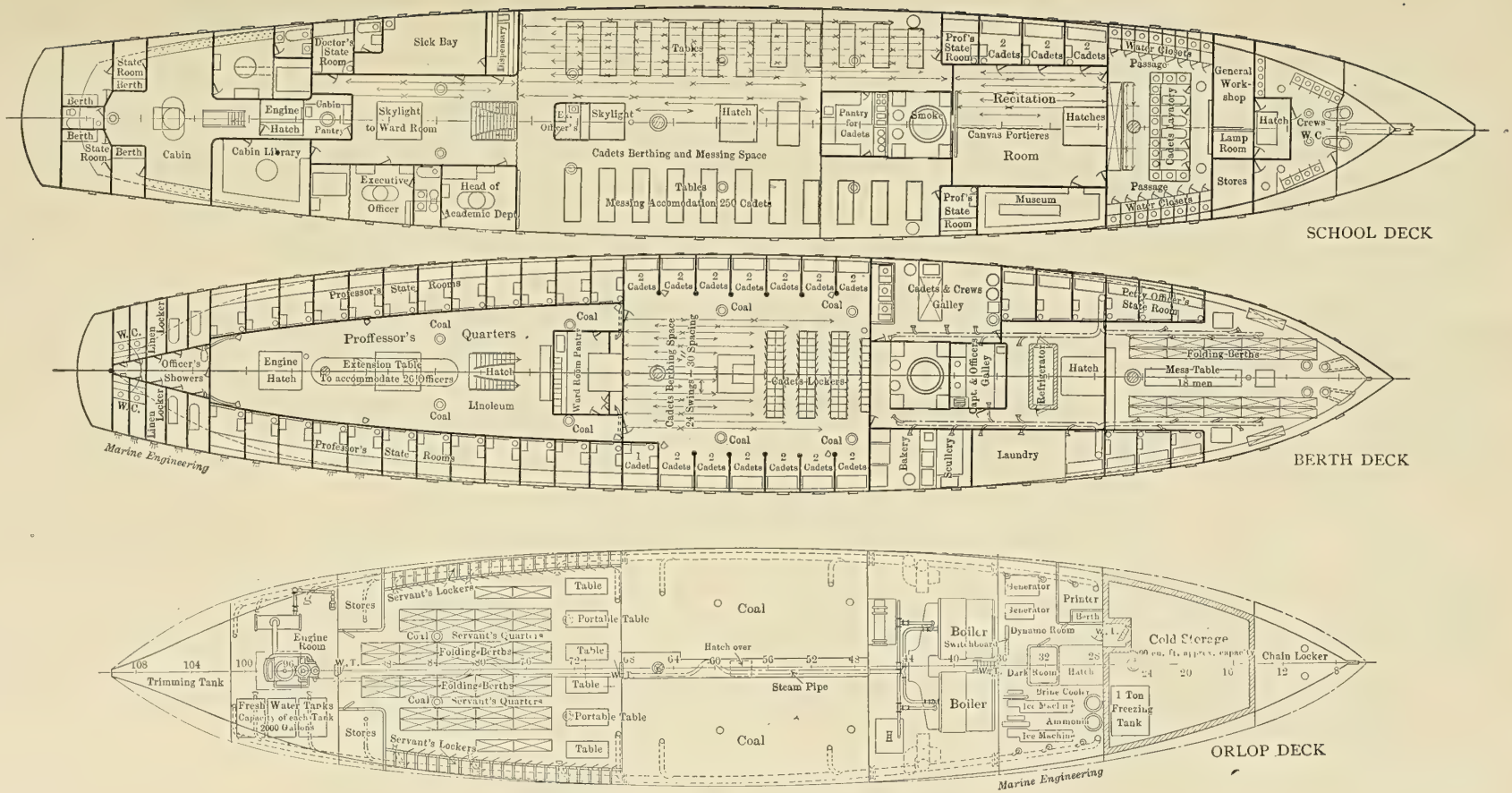
The frames are of dimensions shown in the section, spaced 26 inches centers; the stern tube is of wrought-iron pipe, properly connected with the stern post. The longitudinals, beams, plating, etc., are to be worked in according to the accompanying drawings of the dimensions given throughout. The bilge keels extend for one-half the length of the ship; the inner bottom is to extend across the ship and from frames 36 to 90. The transverse and longitudinal water-tight bulkheads will be worked as shown on the drawings.

Heavy foundations are to be placed in the engine and boiler rooms, as required by the rules. The deck houses are made of plate, laid in panels, with 12-inch finishing plate at top and 15-inch plate at bottom, extending all round the houses.

The bulwarks are formed by the outside plating extending forward, with a wood railing; mast partners are to be located on the decks where required. There is a trimming tank forward and another aft, fitted with necessary connections for drainage, and which will be controlled by valves operated from the deck. Potable water tanks, with a combined capacity of 3,000 gallons of water, are supplied and connected to the fresh-water piping throughout the ship and to the distillers. Stanchions are located wherever necessary to support heavy weights or to strengthen the structure of the ship.

Davits are fitted with the necessary tackle, etc., for stowing, securing, and letting go the anchors. The location of these davits, the boats, and the boat davits is shown on the spar deck plan. Two small galvanized wrought-iron portable hatch cranes are fitted so that they can be attached to any of the several hatches for lowering stores, etc.

The steering gear will be the hand-gear type, with a quadrant fitted on the forward side of rudder stock



DECK PLAN OF THE NAUTICAL SCHOOLSHIP YOUNG AMERICA.

directly under the school deck beams aft, with steering rods led forward under the beams up to the pilot house to a drum with two hand cylinders; the rudder stock extends through the school deck and is fitted for taking a spare tiller when necessary. The coal scuttles are 18 inches diameter, and located as shown. Sluice valves, warping chocks, chain scuttles, hawse pipes, warping pipes are of cast iron, fitted where required.

Carpenter and Joiner Work.—The planks of the several decks are to be of thickness specified in midship section drawing and to be well-seasoned yellow pine. The spar and school decks will be calked, the berth and orlop decks being of tongued and grooved material, covered with linoleum where required. The state room berths throughout the vessel are to be of white pine, with sliding doors of the same material. Each state room will have one berth with lockers below and back, a bureau, wardrobe, and one chair. An electric windlass will be located in the forecastle with double gipsies. A winch, driven by an electric motor, will be located on the spar deck forward of the mainmast, to be used in lifting boats and manipulating the wire cables.

Rigging.—The rigging is of galvanized steel wire

rope, properly served where required, and of the following dimensions:

Lower rigging	3 3-4 ins.
Topmast rigging	2 1-4 "
Topmast backstays	4 1-2 "
Topgallant rigging	2 "
Royal deckstays	2 1-2 "
Royal stays and topmast stays	4 "
Jib stays	3 "
Topgallant stays	2 3-4 "
Royal stays	2 "

and all other wire to be the proper proportion as required.

The blocks will be of the inside machine strap pattern, with sheaves of ash and all ironwork galvanized. The sheaves will be of either smooth galvanized iron or lignum vitæ. Where heavy service is required the bushings will be metal lined. All running rigging is to be of best quality manila rope. All sizes above 2 3-4 inches are to be of four strand.

Masts and Spars.—The lower masts are to be single stick, of Oregon pine, the topmast and jibbooms of yellow pine. The royal yards and floating jibbooms, gaffs, and booms, of spruce, to be fitted with necessary masts and spar lap-welded ironwork. The foremast is 93 feet long and 28 inches in diameter at the partners, the mainmast about 98 feet long by 28 inches, and the mizzenmast 74 feet long by 20 inches. The fore and main topmasts and topgallant masts to be of the same size and to be interchangeable, of about the following dimensions:

Topmast, about 54 feet long by 18 inches diameter.

Topgallant mast, 57 feet long, 12 inches, single stick.

Mizzen topsail, 42 feet long by 12 inches.

Mizzen topgallant, including poles, 43 feet long by 8 inches.

The fore and main lower, double topsail, topgallant and royal yards, and topsail to be of the same length and diameter and to be interchangeable, of the following approximate dimensions:

Lower yard	97 ft.	by	22	ins.
Double topsail yard	91 "	"	20	"
Topsail yard	82 "	"	18	"
Topgallant yard	62 "	"	14	"
Royal yard	82 "	"	8	"

The mizzen spars are approximately:

Cross deck yard, 68 feet long by 16 inches diameter at centers.

Mizzen lower topsail, 64 feet long by 14 inches diameter at centers.

Mizzen topsail yard, 57 feet long by 12 inches diameter at centers.

Mizzen topgallant yard, 45 feet long by 10 inches diameter at centers.

Mizzen royal yard, 35 feet long by 7 1-2 inches diameter at centers.

The fore and main driver gaffs are to be 42 feet in length, including the arms, by 10 inches diameter, and the spanker gaff about 44 feet long, including the poles, with arms about 7 feet long. The bowsprit will be about 44 feet in length, with a topyard length of 19 feet, the greatest diameter being 28 inches. The single-stick jibboom will have a total length of 80 feet, including the poles, and will be 16 inches diameter. The other spars will include a dolphin striker, whisker booms, side-swinging booms, and boat booms.

Sails.—The sails and awnings are of canvas varying in weight from No. 1 to No. 7 for the royals and a No. 8 for boat awnings.

Boats.—The following boats will be supplied: Two 36-foot steam launches, two 36-foot sloop-rigged sailing cutters, ten 28-foot New Bedford whaleboats, two 14-foot wherries, two 12-foot square-ended punts, ten marine-built dories. The total capacity of these boats will be 474 persons, while the complement of the vessel is at 414.

Electric Plant.—The electric equipment will consist of one dynamo of 20 K. W. capacity and one of 10 K. W., directly driven by double-acting steam engines. Current is supplied to about 480 10 C. P. lamps located throughout the ship, and 6 receptacles will also be placed at convenient points for taking current for decorations.

Ice Plant.—A horizontal ammonia refrigerating machine is located in the forward hold, of one-ton capacity in twenty-four hours.

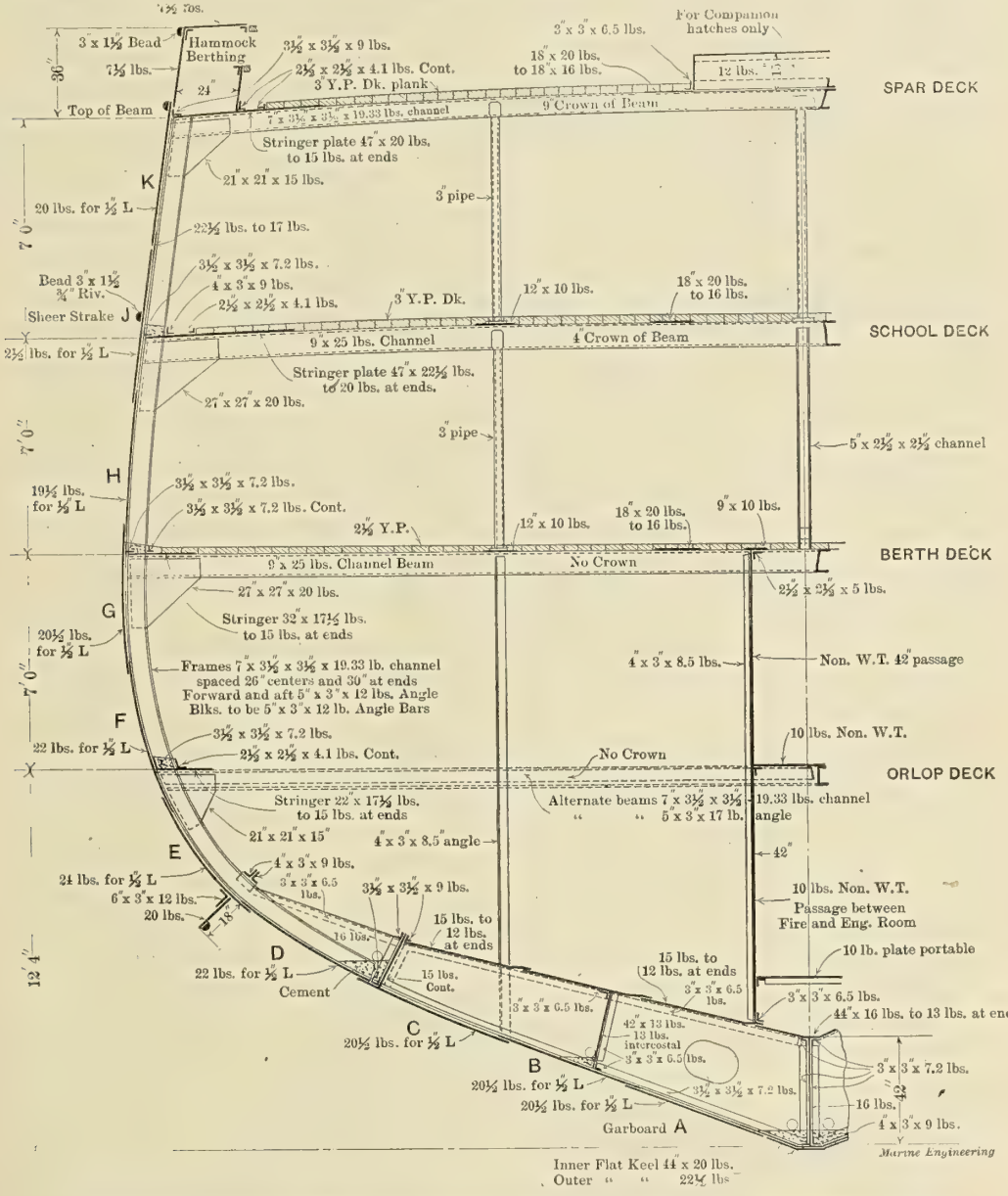
Plumbing and Piping.—The plumbing and drainage is laid out with great care and in the most sanitary pattern. The fresh-water tanks of the hold throughout the ship are piped up with a distiller and evaporator and to the galleys, etc. A 4-inch fire main is laid the entire

Name—Young America.	**Nationality**—American.	**Builder**—Perth Amboy Shipbuilding Co.	
Type—Steam Frigate.	**Launched**—	**Owner**—Nautical Preparatory School.	
Length over all	270 ft.	R. P. M., designed	90
" on load-water line	236 "	I. H. P., "	500
Beam, molded	43 ' 10 ins.	Crossheads, go-ahead bearing surf.	132 ins.
" extreme	44 "	Shafting, crank, thrust, propeller	8 1-2 ins.
Depth to spar-deck beam	33 " 4 "	Main condenser, cooling surface	700 sq. ft.
Draft, forward	18 "	Tubes, outside diameter	5-8 in.
" aft	19 "	Auxiliary condenser	300 sq. ft.
Displacement, corresponding	2,600 tons	**Boilers**	two single-end Scotch
Engines, type	compound	Diameter	10 ft. 6 ins.
Cylinders, diameter	22 and 44 ins.	Length	10 " 6 "
Stroke	24 "	G. S., both	80 sq. ft.
Valves...piston 8 1-2 inches on high, and slide on low		H. S., "	2,520 " "
		Tubes..7 ft. long, 8 1-2 ins. outside diam.	
Thickness of cylinder walls, H. P. and I. P. 1 in., 1 1-8 ins.		**Furnaces**	two each boiler
		Least inside diameter	40 ins.
Steam pressure, designed	100 lbs.	Donkey boiler...100 lbs. steam pres.	

length of the ship under the berth deck, with several plugs conveniently located. The salt-water system of piping is very complete and is connected with the lavatories, tubs, etc.

Ventilation.—In the fire room are placed two steel fans of 10,000 cubic feet capacity at 1 1-2-ounce pressure, supplying fresh air to all the living quarters

columns of the engine, and the front of the engine will be supported by wrought-iron columns. An auxiliary condenser is placed in the fire room, and both will have combined air and circulating pumps. Each cylinder is fitted with a liner, and the high-pressure has a valve of the piston type, 8 1-2 inches in diameter, and the low-pressure has a slide valve. Both cylinders will be


SPAR DECK
SCHOOL DECK
BERTH DECK
ORLOP DECK
Top of Beam
9 Crown of Beam
4 Crown of Beam
No Crown
Hammock Berthing
3" x 1½" Bead
7½ lbs.
24"
30"
3½" x 3½" x 9 lbs.
2½" x 2½" x 4.1 lbs. Cont.
3" Y.P. Dk. plank
7" x 3½" x 3½" x 19.33 lbs. channel
Stringer plate 47" x 20 lbs. to 15 lbs. at ends
21" x 21" x 15 lbs.
20 lbs. for ½ L
22½ lbs. to 17 lbs.
3½" x 3½" x 7.2 lbs.
4" x 3" x 9 lbs.
2½" x 2½" x 4.1 lbs.
Bead 3" x 1½"
¾" Riv.
Sheer Strake
2½ lbs. for ½ L
3" Y.P. Dk.
9" x 25 lbs. Channel
Stringer plate 47" x 22½ lbs. to 20 lbs. at ends.
27" x 27" x 20 lbs.
3" pipe
19½ lbs. for ½ L
3½" x 3½" x 7.2 lbs. Cont.
2½ Y.P.
9" x 25 lbs. Channel Beam
20½ lbs. for ½ L
Stringer 32" x 17½ lbs. to 15 lbs. at ends
Frames 7" x 3½" x 3½" x 19.33 lb. channel spaced 26" centers and 30" at ends
Forward and aft 5" x 3" x 12 lbs. Angle Blks. to be 5" x 3" x 12 lb. Angle Bars
22 lbs. for ½ L
Stringer 22" x 17½ lbs. to 15 lbs. at ends
21" x 21" x 15"
4" x 3" x 8.5" angle
24 lbs. for ½ L
4" x 3" x 9 lbs.
3" x 3" x 6.5 lbs.
6" x 3" x 12 lbs.
20 lbs.
16 lbs.
15 lbs. to 12 lbs. at ends
22 lbs. for ½ L
Cement
15 lbs. Cont.
20½ lbs. for ½ L
For Companion hatches only
3" x 3" x 6.5 lbs.
18" x 20 lbs. to 18" x 16 lbs.
12 lbs.
12" x 10 lbs.
18" x 20 lbs. to 16 lbs.
9" x 10 lbs.
5" x 2½" x 2½" channel
2½" x 2½" x 5 lbs.
4" x 3" x 8.5 lbs.
Non. W.T. 42" passage
10 lbs. Non. W.T.
Alternate beams 7" x 3½" x 3½" 19.33 lbs. channel
" " 5" x 3" x 17 lb. angle
42"
10 lbs. Non. W.T. Passage between Fire and Eng. Room
10 lb. plate portable
15 lbs. to 12 lbs. at ends
3" x 3" x 6.5 lbs.
44" x 16 lbs. to 13 lbs. at ends
42" x 13 lbs.
13 lbs. intercostal
3" x 3" x 6.5 lbs.
3" x 3" x 7.2 lbs.
20½ lbs. for ½ L
3½" x 3½" x 7.2 lbs.
16 lbs.
4" x 3" x 9 lbs.
Garboard A
Inner Flat Keel 44" x 20 lbs.
Outer " " 22½ lbs.
Marine Engineering

MIDSHIP SECTION OF SHIP YOUNG AMERICA, BUILDING BY THE PERTH AMBOY SHIPBUILDING COMPANY.

throughout the ship. A laundry plant is also installed, together with drying rooms.

MACHINERY.

The propelling engine consists of a vertical inverted direct-acting compound engine with high-pressure cylinder 22 inches and low-pressure 44 inches in diameter, the stroke of both pistons being 24 inches. When making 90 revolutions the indicated horse power at 100 pounds steam pressure will be about 500. The engine is mounted on cast-iron bed, with condenser in the back

steam jacketed round the liners and at the top covers. The pistons are of cast iron, the rods of forged steel 3 1-2 inches in diameter, and the crossheads of forged steel; the slipper will be of cast iron with 132 square inches for forward surface and 100 square inches of backing surface. The connecting rod tapers from 3 1-4 inches at the upper end to 3 1-2 inches at the lower end. The valves are operated by the Stephenson link motion, the eccentrics and eccentric straps being of cast iron and the rods of forged steel. Reversing is accomplished by a steam cylinder 8 inches in diameter

by 16 inches stroke, fitted with floating lever and a locking device.

The crank shaft is of forged steel with the slabs shrunk on. The propeller and thrust shafts are also forged steel, 8 1-2 inches diameter, made in one piece, that part of the shaft passing through the stern tube being fitted with a composition casing. The stern tube will consist of an iron or steel pipe flanged at the inboard and threaded at the outboard end. The propeller will be cast iron.

The boilers are Scotch marine type built according to the rules of the United States Boiler Inspectors. The tubes are 7 feet long in the clear, 2 1-2 inches external diameter. The smokestack will be about 50 feet high above grates, the upper 15 feet of it being made telescopic, with proper means for raising, lowering, and guiding same. The donkey boiler is placed forward on the berth deck, built for 100 pounds steam pressure. The pumps are the following sizes:

Feed pump, 4 inches, 10 by 10 inches, vertical double acting.

Donkey feed, 10 inches, 7 by 10 inches, vertical double acting.

Circulating pump.

Fresh-water pump, 4 1-2 inches, 6 by 6 inches, vertical double acting.

Brine and evaporator, 4 inches, 2 1-2 by 6 inches.

Deck, fire and bilge, 12 inches, 10 by 12 inches, vertical double acting.

Engine room, fire and bilge, 10 inches, 7 by 12 inches.

Main air and circulating.

Auxiliary boiler, feed, 3 1-2 inches, 2 1-2 by 4 inches.

An evaporator of 4,300 gallons of potable water in twenty-four hours will be installed, also two distillers, each condensing 2,000 gallons of water in twenty-four hours. The ship will be heated with steam throughout.

Orient-Pacific Liner Orontes.

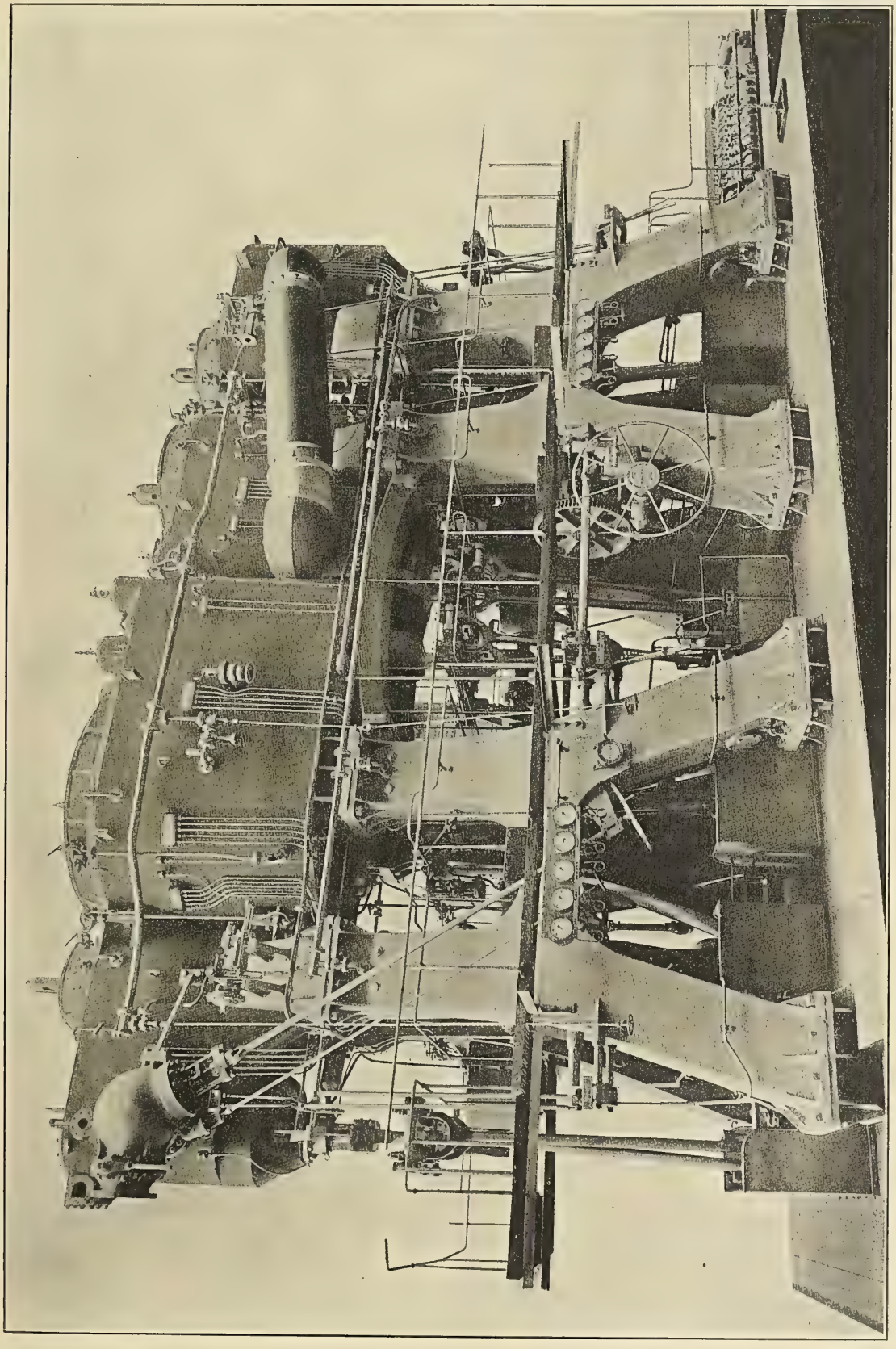
The accompanying illustration and information concerning the engine of the Orient-Pacific *Orontes* are reproduced from *London Engineering*. The vessel, which is for the Australian mail and passenger service, was built by the Fairfield Shipbuilding and Engineering Company, Ltd., Govan, Scotland. The principal dimensions are to be found in the accompanying table. She has accommodations for 323 first- and second-class saloon passengers, besides many third-class. The cabins are arranged for one, two, or three passengers. Some of the inside rooms are built on the Bibby or tandem system, which gives these inner rooms light and air from the porthole in the side of the ship. The first-class dining saloon is on the upper deck. The smoking room is on the promenade deck, aft of the dining saloon, and the drawing and writing saloon on the same deck, forward. The second cabin and dining saloon are placed on the same deck, aft, extending from side to side, with seating capacity for 126 persons. Coaling is done through ports in the ship's sides, above the level of the main deck. The *Orontes* is on the Admiralty list of vessels suitable for armed cruisers.

The most striking feature in the design of each engine is the framing, which will be seen by referring to the engraving, gives free access to all cranks. The engines are quadruple expansion, with cylinders arranged on the Schlick-Tweedy system of balancing. The high-pressure cylinder is placed at the forward end, and next to it is the low-pressure cylinder, the cranks being at right angles. The two intermediate cylinders form the after pair, the first intermediate cylinder being the aftermost. The cranks of this pair are at right angles. The valves of the high and first intermediate are of the piston type, the others are flat, and all are worked by the Stephenson double motion.

There is a separate condenser for each engine, constructed of steel plates, and supplied with circulating water by centrifugal pumps driven by Allen engines. A feed pump, fitted to the main engine, raises the water to the feed heater and from thence it is pumped by two sets of independent Weir pumps to the boilers. The engine and boiler rooms are fitted most completely with auxiliaries. Electric current is generated by four sets of Allen compound engines and dynamos, of a total capacity of 110 K. W. A Brown steering engine is placed in the steering house on the boat deck, and is controlled from the bridge amidships by means of a telemotor. The usual steam windlass, winches, and capstans are supplied. There is also a large refrigerating plant installed, which is used in preserving the galley stores and also in refrigerating 74,000 cubic feet of the holds. The plant consists of two units, which work on the dry-air system.

NAME—Orontes. NATIONALITY—British. TYPE—Ocean passenger.
LAUNCHED—1902. BUILDER—Fairfield Shipbuilding and Engineering Company. OWNER—Orient-Pacific Line.

Length of perpendiculars	530 ft.	**Boilers**	four single- and two double-end
Beam, molded	58 " 3 in.	Pressure	215 lbs.
Depth to upper deck	38 " 2 "	Diameter	16 ft. 6 ins.
Load displacement	15,450 tons	Length	19 ft. 8 ins. and 11 ft.
Gross tonnage	9,000 tons	Number of furnaces, total	32
Engines	twin, quadruple	Heating surface, total	26,000 sq. ft.
Arrangement	Schlick-Tweedy system	I. H. P., total on trial	9,500
Cylinder diam, 27 1-4, 39, 56, and 80 ins.		Speed on trial	18.18 knots.
Stroke	60 in.		
Valves	piston on H. P. and first I. P.		



FOUR-CYLINDER QUADRUPLE-EXPANSION STARBOARD ENGINE ON THE STEAMSHIP ORONTES, BUILT BY THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, LTD., GOVAN, SCOTLAND.

The boiler installation consists of two double-end and four single-end boilers, which are placed in two boiler rooms separated by water-tight bulkheads. The boilers are arranged to work on the Howden forced-draft system, four fans of large diameter being fitted on the boat deck near the funnel casing. Before leaving the builder's hands the *Orontes* attained a speed of 18.18 knots; this run was following a 12 hours' steaming at slightly-reduced power.

with state rooms at the sides. At the after end there is a comfortable smoking room, while the space at the forward end is fitted as an observation room with large square windows.

The vessel is of handsome appearance, has three funnels, and is rigged with two pole masts.

The machinery was built by R. and W. Hawthorn Leslie and Company, Ltd., and consists of two sets of triple-expansion engines working on four cranks and

NEW STEAMER PRINCESS VICTORIA, FOR THE VANCOUVER-VICTORIA SERVICE OF THE CANADIAN PACIFIC RAILWAY COMPANY.

New Steamer for the Pacific Coast.

The *Princess Victoria*, recently built by C. S. Swan and Hunter Ltd., Newcastle-on-Tyne, England, for the Canadian Pacific, is a steel twin-screw steamer of the following leading dimensions: Length B. P. 300 feet, beam extreme 40 1-2 feet, and depth molded 18 1-2 feet. She has been designed for the company's mail and passenger service between the city of Vancouver and Victoria and will accommodate a large number of passengers, all above the hurricane deck. On the upper deck aft is a large deck house containing the dining saloon, with seating accommodation for 90 saloon passengers, and also the galley and pantry. From the after end of the engine casing to the stem the plating is carried up to the hurricane deck, and in this space at the after end are the rooms for the engineers, petty officers, etc., whilst forward the space is reserved for second-class passengers. On the hurricane deck is placed a large house, almost the whole width of the vessel and 245 feet in length. Along the sides are the state rooms for the first-class passengers; the space between these cabins being fitted up as an extensive sitting room, access being obtained to the dining saloon below by a commodious staircase aft of the engine room. At the forward end of this house, space is reserved for the second-class entrance and smoking room, and main staircase for first-class passengers to give access to the deck above, this deck having a large opening which gives this portion of the sitting room a lofty and handsome appearance. Only sufficient deck remains to make a gallery for access to the second tier of state rooms. The house on this deck extends for a length of 170 feet and is arranged similarly to the house below it,

balanced on the Yarrow-Schlick-Tweedy system. The cylinders, 24, 40, 43 1-2, and 43 1-2 inches diameter, with a common stroke of 33 inches, are expected to develop about 5,500 indicated horse power on the trial trip. Steam is supplied by six single-end boilers, each 15 feet diameter by 11 feet long, working at a pressure of 160 pounds per square inch. The draft will be assisted by fans, giving modified forced draft. This machinery is expected to drive the vessel at a speed of 18 knots an hour in service.

Causes of Delay in Building Warships.

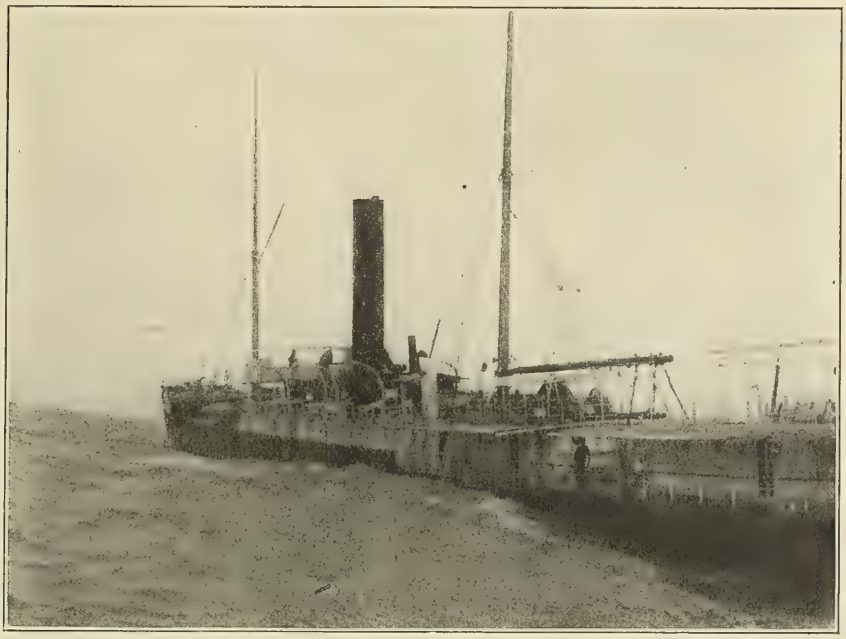
The report of Rear Admiral Bowles, Chief Constructor of the Navy, on the question of the delays in the completion of the United States warships, is a large document and goes into much detail. Practically no ship contracted for by the government has been delivered on time. The causes for the delays are attributed to the following facts: First, incomplete plans; second, changes in designs after the awarding of the contract; third, delays in delivery of armor, due to several causes, among which are improved methods of manufacture of armor, and in some cases refusal of Congress to authorize the department to contract for armor; fourth, a thorough system of inspection; fifth, inability of the builders to secure material on time; sixth, inadequate supply of skilled workmen or insufficient technical staff at the builder's yard.

Monitor Nevada.—The United States monitor *Nevada*, which for several years has been under construction at the Bath Iron Works, was turned over to the government at the Portsmouth Navy Yard March 5.

The Loss of the Madiana.

On the clear night of February 10 the Quebec Steamship Company's ship *Madiana* struck a reef off the coast of Bermuda and at once sank on a ledge. It was 4 o'clock when the vessel struck and five minutes later the saloon was filled with water. A heavy sea was running at the time, but fortunately the ship held to the ledge, otherwise she might have gone down with all on board. At daylight assistance arrived and the passengers were taken off on tugboats. The governor of the island appointed a marine court of inquiry to investigate the circumstances attending the loss of the ship, and a brief of the findings of the court is as follows:

From the sights taken at 8.30 A.M. and at noon on the day before the accident, the master set his course for a point seven miles east of St. David's Light, and, according to the testimony, the course was not altered until within a few minutes of the ship striking. The two sights did not agree and the master discarded his morning sight and based his calculations on the noon sight. Evidently the morning observation was the correct one. As the master had run the course as laid down to a point seven miles east of St. David's and failed to pick up the Light, he should have run slowly and not at full speed as was the case. The visibility of Gibb's Hill Light had been decreased a few months previous to this time, owing to the lighthouse being struck by lightning. The master was not acquainted with this fact. The ship's log was not presented before the court. The court also recommended that only men who can understand and speak English should be employed to steer British passenger ships. On board the *Madiana* there were Italian helmsmen. No officers' certificates were canceled.



STEAMER MADIANA, ASHORE ON A REEF OFF THE ISLANDS OF BERMUDA.

EFFICIENCY OF PROPELLERS AND RUDDERS.

BY GEORGE H. WILSON.

The question as to the best location for the propellers and rudder of a vessel is one that has received a great deal of attention from time to time, resulting in various opinions and theories as to the proper solution thereof. Some of the best authorities and ablest men among naval architects have dealt with this subject, pointing out the various good features of certain systems and the bad ones of others, among whom are such men as Rankine, Froude, Tideman, Reynolds, Durand, Isherwood, and Taylor. With such men collaborating on the same subject, although with varied ideas, it would be reasonable to suppose that a solution had been effected. Beyond a doubt the experiments made have been of invaluable aid to the profession, but it seems as if one or two of the most important thoughts promulgated by these researches have not been much improved upon.

The points to which I refer, and which will be dealt with in this article, are the changes in the location of the rudder and the altered position of the propellers proposed by some of the above authorities. To effect an improvement in the steering qualities of a vessel and to increase the propulsive coefficient must be the aim of any change in this direction.

In the propeller experiments made by Professor Rankine, some points of which bear upon this subject, he assumed as a basis for his investigation that the number and surface of the blades in a screw would be adjusted by rules derived from practical experience, so that the stream flowing aft would consist of the whole cylinder of water in which the screw revolved; that is to say, the race was assumed to consist of a cylindrical column of water having the screw disc, less the area of the boss, for its athwartship section, the motions of the particles assuming a spiral path.

On these assumptions it was possible to approximate, (1) to the quantity of water acted upon in a given time; (2) to the sternward momentum generated in the same time; (3) to the loss of thrust due to friction; (4) to the effect on the efficiency of the screw due to working in water previously disturbed by the vessel. In connection with the subject in hand we have to deal with number 2 as regards the spiral character given to the particles, and with number 4 in toto, reference to which will occur later.

The investigations made by the late Mr. Froude were along entirely different lines and had to deal with the frictional and normal resistance of each unit of area of the various blades, the summation of which was taken as the approximate total effect of the propeller. The aggregate effect must necessarily be approximate, owing to the disturbed condition of the water over different areas due to the friction from adjacent areas, friction from other blades and from the wake of the vessel. Here again the question of the disturbance of the element in which tne propeller is working is brought out as a salient feature of its efficiency. As this point is one that affects the subject in hand, it will not be out of place to dwell on the same.

Prof. Reynolds says that the single screw is at more of a disadvantage than the twin screw, as the whole propeller is working in the frictional wake of the vessel, the upper blades exerting greater thrust than the lower ones owing to the different velocities of the wake, while the twin screw has only the ends of the blades working in it. I will attempt to show that the twin screw is at a greater disadvantage as regards the difference of the thrust than is the single screw, and to support this theory I will submit the following reasons:

1. The "frictional wake" of a vessel, it is well known, is a body of water adjacent to the skin of the vessel, which by reason of frictional contact with the same assumes a motion similar to that of the vessel, although with somewhat less velocity. The distance over which this friction exerts an influence on the particles of water varies with the nature of the skin and also as the speed of the vessel.

2. The vessel having given a forward motion to a body of water in its immediate vicinity, it follows that there must be some region, not affected by the motion of the vessel, where the water is at rest. Lying between the two must be a region of disturbed water having a vacillating tendency. As the force exerted on one side tends to give it a forward motion and the inaction on the opposite side tends to retard, it is obvious that an eddying effect must be the result, with a slight tendency toward a transverse motion.

3. Beyond these disturbed elements lies that body of water which is not affected by the passage of the vessel and is consequently at rest.

With these influences acting on the water approaching the propeller, the following conditions of water in which the propeller is working can be deduced and divided to suit the foregoing subdivisions:

1. The water nearest the ship, the frictional wake, has a forward motion, the speed of which is somewhat less than the speed of the vessel. This has the effect of making that body of water, relatively, a body of nearly still water as regards the propeller.

2. The water outboard of, and adjacent to, the wake has a forward-athwartship motion imparted to it, which condition is in the nature of an eddy.

3. The water outboard of all the foregoing has no motion at all imparted to it by the vessel.

Analyzing these subdivisions, some approximation to the relative effect of each on the efficiency of the propeller can be reached.

In regard to No. 1, it is found that about two-thirds of the propeller blade, when at a point near the skin of the vessel, are working under this condition. In this instance the greatest effective thrust is experienced. In No. 2, the thrust is somewhat diminished, but owing to the narrower parts of the blades and the hub being in this region, the effect is not so great. In the case of No. 3 the thrust is further diminished and should be at a minimum. The last condition affects somewhat less than that two-thirds of the blade farthest from the skin of the vessel.

With the above conditions of water in the neighborhood of the propellers and the consequent variations in the thrust, it can readily be seen that these conditions are responsible for a certain amount of the shocks and vibrations which are transmitted from this region to the propeller shafts and thence to the engines and to the ship. As these vibrations are always more noticeable in and around the stern of the vessel, it goes to verify the statement that certain of them must originate in that vicinity.

It is hardly possible to remedy the defects in the efficiency of the propeller due to the causes just mentioned, as it would necessitate placing the propellers either at a greater distance out from the side of the vessel, or at a considerable distance abaft of the stern post, so as to allow of their working in an element where the conditions are similar, both of which must be discarded owing to their impracticability. The efficiency of the propellers can, however, be increased in one way to a certain degree.

Aside from the complex conditions of the water in which the propellers are working, the angle at which the stream lines approach the propellers should be taken into consideration. In vessels having a very long run and necessarily fine lines, this angle is very small and of no great consequence, but in vessels with a short run the angle is of considerable import. It goes without saying that a propeller will have the maximum efficiency, everything being equal, where the water is brought to it in lines of flow parallel to its axis. This, of course, is a condition hardly obtainable with some of the present constructions and lines, but this defect can be partly overcome and somewhat remedied by changing the location of the propellers, as shown.

With this idea in mind it is suggested that the propellers be located at the farthest practical point astern. This would, of course, be the position occupied at present by the rudder. It is just this shifting of the positions of these two functions of a vessel that the author would advise; to place the twin screws where the rudder is now located, and *vice versa*, as is shown in sketches numbers 2A and 2B.

The advantages gained from this alteration of the position of these two functions I will separate under four heads, as follows:

A. Increased efficiency of propellers, due to working in nearly parallel stream lines.

B. Increased efficiency of rudder, due to working in more advantageous stream lines.

C. Increased efficiency of rudder, due to working in better conditions of water.

D. Increase in the thrust properties of the stern stream lines.

As regards the first of these headings, it is seen by

As the proposed location of the propellers gains for them the action of nearly parallel water lines or stream lines, the conditions cited in the latter case above are obviated.

In connection with the shifting of the propellers and the rudders, some of the earlier model trials by the late Mr. Froude gave a certain amount of data, but

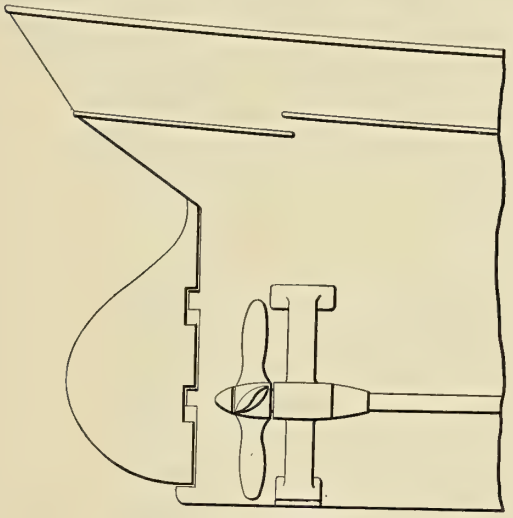


Fig. 1-A

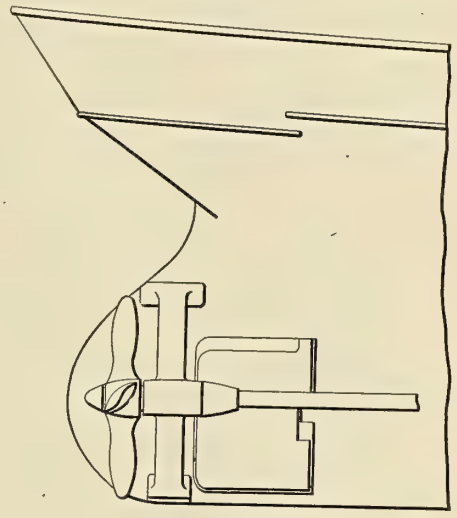


Fig. 2-A

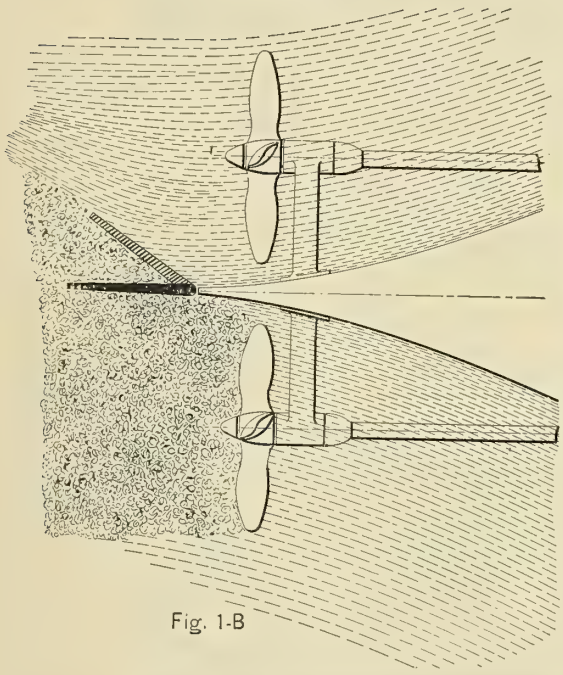


Fig. 1-B

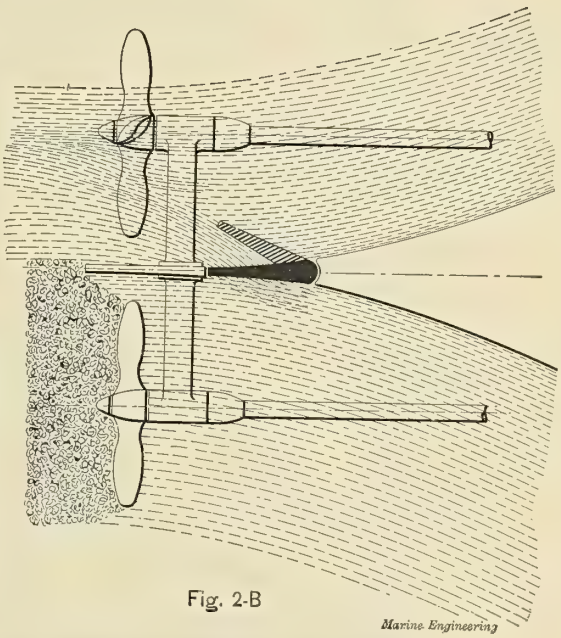


Fig. 2-B

Marine Engineering

STREAM LINES FOR THE USUAL, AND SUGGESTED NEW LOCATION OF RUDDERS AND TWIN SCREWS.

referring to sketch number 2B, previously mentioned, that the angle of the stream lines at the propeller is considerably reduced from that shown at the same relative point in sketch number 1B. The action of the stream lines in the former sketch is to exert their maximum efficiency on the propeller blades, while with the water advancing to the propeller at a considerable angle, as in the latter sketch, there is a tendency for the particles to slip off before performing in full their function of resistance.

the accuracy of these is hardly accepted at the present day. Any increase in power, however, gained by shifting the propellers aft, is, no doubt, caused by a decrease in the resistance of the vessel owing to the stern stream lines being less affected, but a portion of this gain would be due to the fact of the propeller working in better conditions of water. It is suggested that the gain effected by the thrust of the stern stream lines would be nearly overcome by the loss due from the wake gain of the propeller. I hold that the shifting of

the propeller a certain distance aft does not prohibit the propeller from gaining something from the frictional wake, as it is well known that that body of water drags along after the stern a considerable distance. The gain would not, of course, be so great as in the other case, yet I doubt if the difference will counteract the gain from the thrust spoken of above.

As regards the second subdivision, *B*, "Increased Efficiency of Rudder, Due to Working in More Advantageous Stream Lines," there are one or two points to discuss. I think that when I make the assertion that by placing the rudder in the position shown in sketches numbers 2A and B the efficiency has been increased, I will not be contradicted. It is well known that the maximum efficiency of a rudder for turning effect would be with the rudder at an angle of about 45 degrees, were it not for the skin friction and other causes. Owing to these the angle of about 30 to 35 degrees has been found to give the best results.

In the present location of the rudder the stream lines are practically parallel to the center line of the vessel. In the proposed location the stream lines would form a considerable angle with the center line. As the turning effect of a rudder is dependent upon the angle of its face with the water approaching, it necessarily follows that the angle of the stream lines plays an important part in this connection. With the rudder in the position shown in sketch number 1B, when turned at an angle of 35 degrees, the angle of impact of the stream lines is about 145 degrees. To obtain the same angle of impact with the rudder in the proposed location, as shown in sketch number 2B, an angle of about 27 degrees is all that is required for turning. The result of this decrease in the turning angle is clearly a gain in favor of the latter proposition. Although the angle of turning has been reduced, the fact that the rudder is working in angular stream lines prevents a like decrease in the moments and strains due to twisting. The reduction in the amount of travel, however, of the different parts, in connection with the rudder, tiller, steering ropes, and engines, allows of the decrease in size of a number of these parts, causing a like reduction in weight. Owing to the reduced motion of the working parts and to the new location of the rudder, which is at a beamier part of the vessel, all of this gear can be carried lower down, thus insuring (in the case of a man-of-war) a perfect protection for these parts.

On the subject coming under the heading marked *C* a great deal can be said. It has been argued, when the positions of rudder and propeller are in question, that it is necessary to have the rudder abaft the propeller, so that a vessel with little or no headway would still have steerageway by reason of the action of the propeller race on the rudder. This argument would hold good for single-screw vessels, but it hardly seems adapted to the twin-screw type. By referring to sketch number 1B, it will be seen that the propeller on the side opposite to the one to which the rudder has been turned, if given an ahead motion, will materially aid in the steering, but will have no action on the rudder whatever. On the opposite side of vessel, however, the propeller will aid the steering effect of the rudder, but will counteract this effect by the contrary turning moment of its own action. This disproves the argument just mentioned.

As regards the action of the rudder on the stream lines running to the propellers, the new location has an advantage, in that when the rudder is hard over, with both propellers going full speed ahead, the propeller necessary to aid in the turning is unaffected, while to the one detrimental to turning the stream lines are interrupted, decreasing its efficiency to a considerable extent, and thereby aiding in the turning of the vessel.

With one propeller going full speed ahead and with the other stationary the rudder in the new location has also an advantage over the rudder in the old position. In the old position, with the propellers working as mentioned, the rudder will, of course, be turned toward the stationary wheel; this propeller is dragging a certain amount of water along behind it, causing eddies, etc., or, in other words, is keeping a certain amount of water from acting on the rudder at all, and is disturbing nearly all the water in that region, so that the efficiency of the stream lines acting on the rudder is reduced by about one-half. This state of affairs could not exist with the rudder located as I have suggested, as the solid stream lines, with their initial momentum, would act on the rudder and would then go to the propellers, where they can do but little harm.

With the two propellers working in opposite directions the rudder plays but a small part in the turning of the vessel, but even in this instance the proposed new position has the advantage over the old. As the vessel has a certain amount of headway, this will act with the rudder in the new position in helping to turn the vessel, while with the rudder in the old position the propeller would draw all the water away from the working face of the rudder.

With both propellers out of action the forward position is undoubtedly the best position for the rudder, as was the case with one wheel going ahead and one wheel stationary.

These various conditions of running and turning having been discussed, it is easily seen that the new position of the rudder has the advantage in every case.

The last heading remains for consideration, and, although referred to previously in this article, I deem it necessary to revert to it at this point. It is a well-known fact that as the stream lines travel aft along the ship's side and bottom they close in around the stern and in so doing exert a forward pressure on the vessel, which helps to counteract the resistance experienced when pushing these stream lines outward at the forward part of the ship. In the present location the propellers tend to draw these stream lines away from the stern before they have performed the above duty. Therefore, thrust deduction. Were it possible to so locate the propelling power that the stream lines would be unaffected until after having performed their thrust properties, there is little doubt that there would be an increase in speed. The wake gain would, however, be reduced, as previously mentioned, but, owing to the wake extending some distance abaft the stern, I doubt if there will be enough reduction to counteract the above gain.

This location of the propelling power being impracticable, it remains to place the disturbing agency as far aft as possible. To do this is not only possible, but is also very practicable, as will be seen by reference to sketches numbers 2A and B, which give a good idea

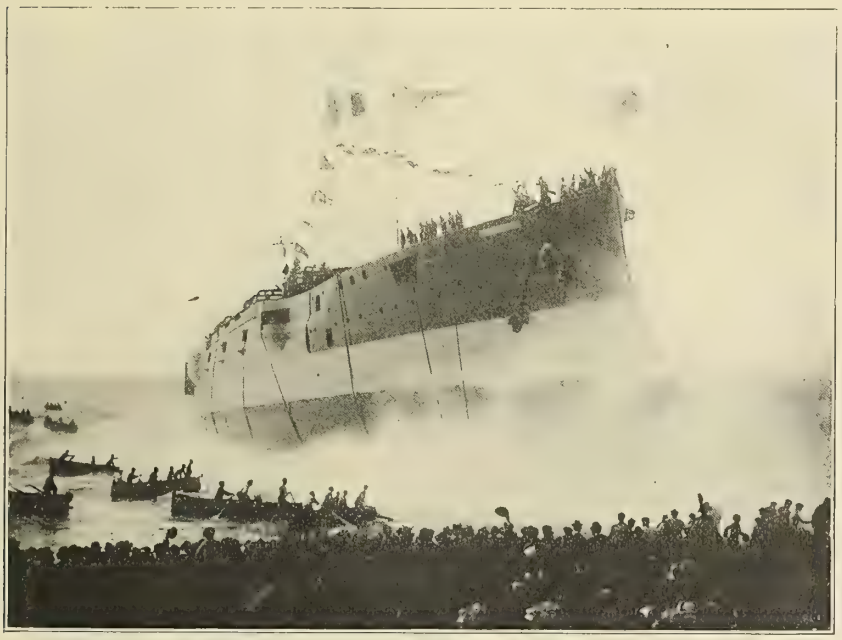
of the shape of a stern to allow for this development. In the case of vessels of a certain shape of stern the load-water line can be decreased in length to some extent. From this sketch it will be seen that there are no structural difficulties in the way of this arrangement.

It may be a surprise to some that this arrangement has been patented for some time, but patents were granted in this country and in Europe to Mr. Walfrid Sylven, on "Improvements in the Construction of Steamships and Rudders and in Locating Rudders and Propellers."

The author is indebted to Mr. Sylven for selections from his work on this subject, which have been incorporated in this article.

Another Picturesque Launch.

The correspondent from Genoa sends us the accompanying views of the launch of the battleship *Moreno*, built by Messrs. Ansaldo and Company for the Argentine Republic. The launch took place on February 9, and was witnessed by a large crowd both ashore and afloat. The ship is a sister ship of the *Rivadavia*, previously described in these columns. On an occasion of such a launch as this, the shipbuilders throw open the yard to the public and the business in the town is practically suspended, so that all may witness the launch. This yard, located in the little seaport of Sampierdarena, near Genoa, as is seen in the view, lies at the foot of hills covered with gardens and vineyards. The ship



TWO VIEWS TAKEN AT THE LAUNCH OF THE ARGENTINE BATTLESHIP MORENO, AT SAMPIERDARENA, GENOA, ITALY.

was launched with the usual Italian ceremony, consisting of a priest pronouncing a benediction as the ship went overboard.

Name—Moreno.	Nationality—Argentine Republic. Type—Battleship.
Launched—Feb. 3, 1903.	Builder—Ansaldo and Company. Owner—Argentine Republic.
Length over all..... ..... 357 ft.	**Engines,** type... ...twin-screw, triple expansion
Between perps..... ..... 344 "	Cylinder diam... . ..... 42 1-2, 63, 92 3-4 ins.
Beam, extreme..... ..... 61 " 4 ins.	Stroke..... ..... 46 "
Depth..... ..... 40 "	Cooling surf. condensers, each... 6,910 sq. ft.
Launching weight .... 3,000 tons	I. H. P., designed..... 13,500
Mean load draft .. .. 24 ft.	Speed, " .... 20 knots.
Corresponding displacement..... .. 7,700 tons	**Boilers,** number of.....four double-end, four single-end Scotch.
Coal supply, maximum..... ..1,100 tons	Steam pressure..... ..... 165 lbs.
Steaming radius at 10 knots..9 000 miles	G. S..... ..... 893 sq. ft.
	H. S..... ..... 24,272 " "

Steamship Maine.—On February 11 the steamship *Maine,* one of the six large ships being built for the Atlantic Transport Company in American yards, was launched from the works of the Maryland Steel Company, Sparrow's Point, Md. The over-all length of the *Maine* is 507 feet; beam, 58 feet; draft, loaded, 27 feet 4 inches; displacement, loaded, 17,200 tons. A general description of this ship was given in Marine Engineering of January, 1903.

Lighthouse Tender Heather.—In the presence of a number of naval officers the lighthouse tender *Heather* was launched on November 17 from the yard of Moran Bros. Company, Seattle, Wash. The vessel is built for the United States Lighthouse Service and the principal dimensions are as follows: Length over all, 178 feet 6 inches; between perpendiculars, 165 feet; beam, molded, 28 feet 6 inches; depth of hold from top of keel to top of beam, 14 feet 11 inches. The boilers and machinery are now being installed, and it is expected that the vessel will be delivered early in April.

Novel Way of Making a Joint.

There are many ways of making a joint, but that which was done by my chief on board the S. S. ——— is the only thing of the kind I have ever heard of. The joint on the bonnet of the main feed check valve blew out on the after boiler and it was impossible to shut the valve or hold the water in the main boiler, although the extra feed, donkey, sanitary pumps were all on; when the ship rolled we could see the water in the glass. The assistant on watch called the chief engineer down below and expected to see the fires drawn and a new joint made, which would take at least ten hours.

The old joint was made up with wire gauze between steam rubber, and the rubber blew out, leaving the gauze

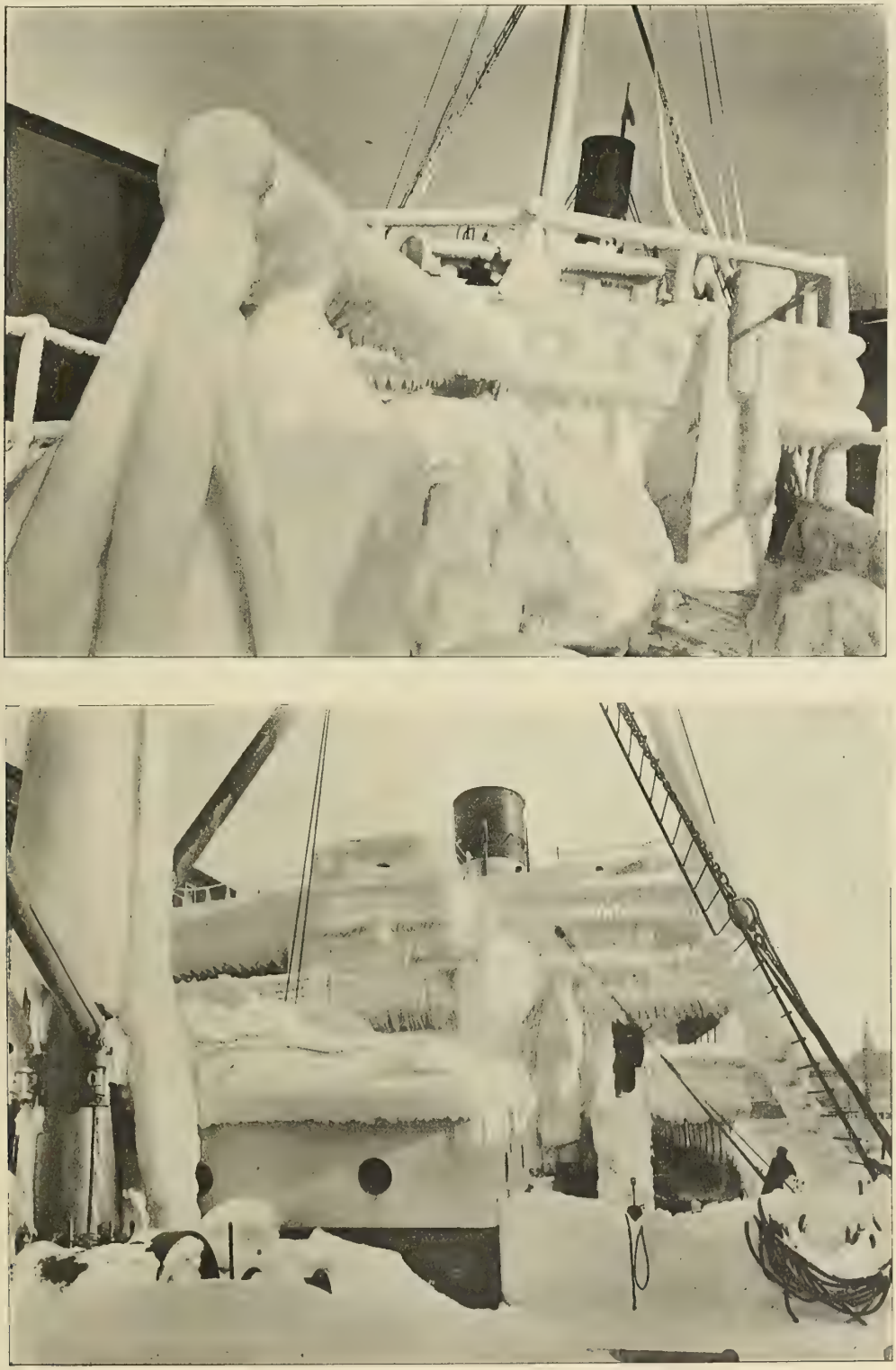
AN ICE-COATED ANCHOR DAVIT.

in place. The chief called for a piece of hemp rope and had it cut up into 2-inch lengths, and then, standing over the filter box, he unraveled the pieces and dropped them into the water. Inside of half an hour the joint was made and did not leak a drop. The hemp strands were carried over with the water by the feed pump, and as the water escaped through the leak the strands caught in the gauze and were woven through it like a basket. The gasket made would be hard to duplicate, and it may still be seen in the "old man's" room as a sample of engineering originality. Cadet.

Wireless Telegraphy.—On a recent passage the steamship *Etruria* published a daily newspaper with dispatches received by wireless telegraphy from the stations on each side of the Atlantic.

Ice-Decked Steamers.

The past winter has been a record breaker for storms at sea and the shipyards of this coast have been filled with repair work of both large and small craft. The hardships in navigating the tempestuous North Atlantic during the winter months may be inferred by looking at the accompanying pictures, taken on board two steamers which had experienced what may be termed a rough passage. The flying spray froze to anything it came in contact with, and the shrouds and rigging were increased many times in size. Another winter season has closed and we may now look for calm seas.



DECK VIEWS OF TWO STEAMERS IN PORT AFTER A COLD AND ROUGH PASSAGE ON THE NORTH ATLANTIC.

Modern Steam Turbine Yachts.

BY FRANK C. PERKINS.

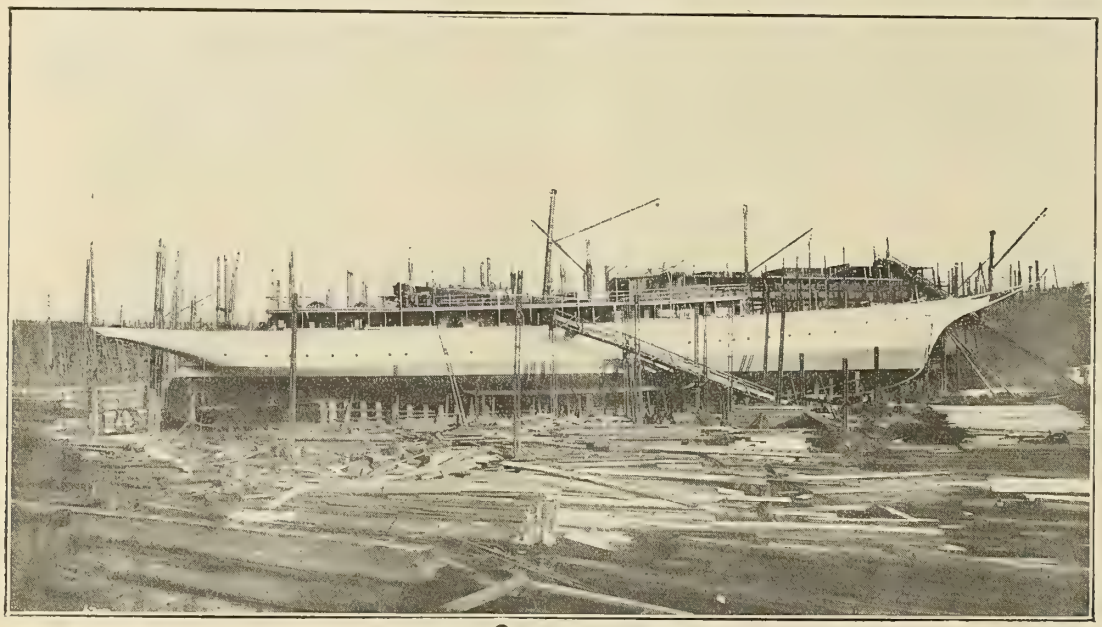
The marine steam turbine is rapidly finding its way into service for the propulsion of modern high-speed yachts. It may be of interest to consider a few details of construction of some of these boats, and the accompanying illustrations, Figs. 1, 2, and 3, show one of these boats under construction, as well as the shipbuilding shed, yard, and shops at Glasgow where they are built.

The turbine steam yacht *Emerald* was constructed at the plant of Alexander Stephen and Sons, Ltd., of Linthouse, Govan, Scotland. The shops are thoroughly equipped with the latest machine tools, jib and traveling cranes, and the shipbuilding yard has an ideal location for the construction and launching of these boats.

This yacht is owned by Col. H. McCalmont. The boiler is of the Yarrow water-tube type, and the general construction of the yacht is along the lines of the torpedo-boat class.

Another interesting high-speed steam turbine yacht is the *Lorene,* being constructed for Mr. A. L. Barber, New York city. This yacht is 260 feet 8 inches long, and has a beam 33 feet 3 inches, while its displacement is 2,800,000 pounds. The turbines for this boat, which is being built at Leith, Scotland, are also of the Parsons marine type, and the boilers and hull were designed by Ramage and Ferguson.

The first marine steam turbine boat, constructed several years ago, known as the *Turbinia,* it will be remembered, made the high speed of nearly 35 knots, with a total of over 2,000 H.P. Soon after the torpedo-boat



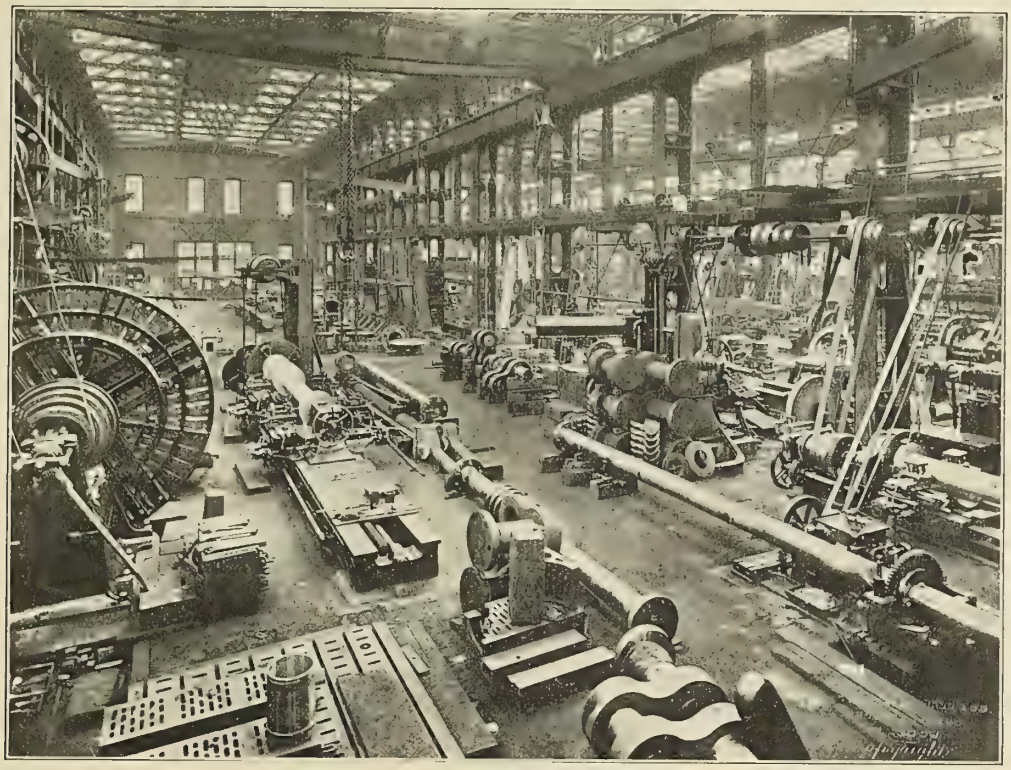
STEAM TURBINE YACHT EMERALD.

The *Emerald* is equipped with three sets of steam turbines of the Parsons marine type, each driving a single length of shafting, with an aggregate developed horse power of 1,500. Of the three shafts which are directly connected to the steam turbines, the two outside shafts each have two propellers of about 20 inches diameter. The central shaft is fitted with one propeller about 36 inches in diameter, and all of these wheels are constructed of manganese bronze.

The length of the *Emerald* is 236 feet, the depth 18 1-2 feet, and the beam 28 2-3 feet; the above dimensions giving a tonnage of 1,512,000 pounds, yacht measurement. It is stated that a speed of 16 knots per hour can easily be attained with an entire freedom from vibration.

The steam turbine yacht *Tarantula* was constructed for a speed of 24 knots per hour, and has a 16-foot beam and a total length of 160 feet. The turbines for this boat developed 2,500 H.P. and are three in number. Two of the turbines are of the Parsons low-pressure type, which drive the two outer shafts, each of which is provided with three screws. The high-pressure turbine is connected with the central shaft, which also has three propellers, making a total of nine screws in all. destroyers *Viper* and the *Cobra* were constructed, with a speed of from 35 to 40 knots, and later were built the steam turbine passenger boats *Queen Alexandra* and *King Edward,* which have both given excellent satisfaction, and a number of vessels are now being constructed, and are proposed, utilizing steam turbines instead of the reciprocating engine. It is claimed by Mr. Parsons that the use of several screws on each propeller shaft has a decided advantage over a single screw of larger dimensions, when the propeller shaft is operated at the high speeds necessary for running steam turbines.

Spare Parts Dutiable.—The attorney-general has rendered a decision whereby spare parts of machinery imported to this country by foreign steamship lines and held in reserve on the wharves at American ports are subject to duty the same as other machinery of this class. The only exception to be made is in case such parts are to be brought over to meet an emergency that already exists. The decision is the result of an application made by the Cunard Steamship Company to land a steel shaft without payment of duty, which was to be kept on the company's dock at New York for use on the steamship *Umbria* or *Etruria* in case of emergency.



MACHINE SHOP.

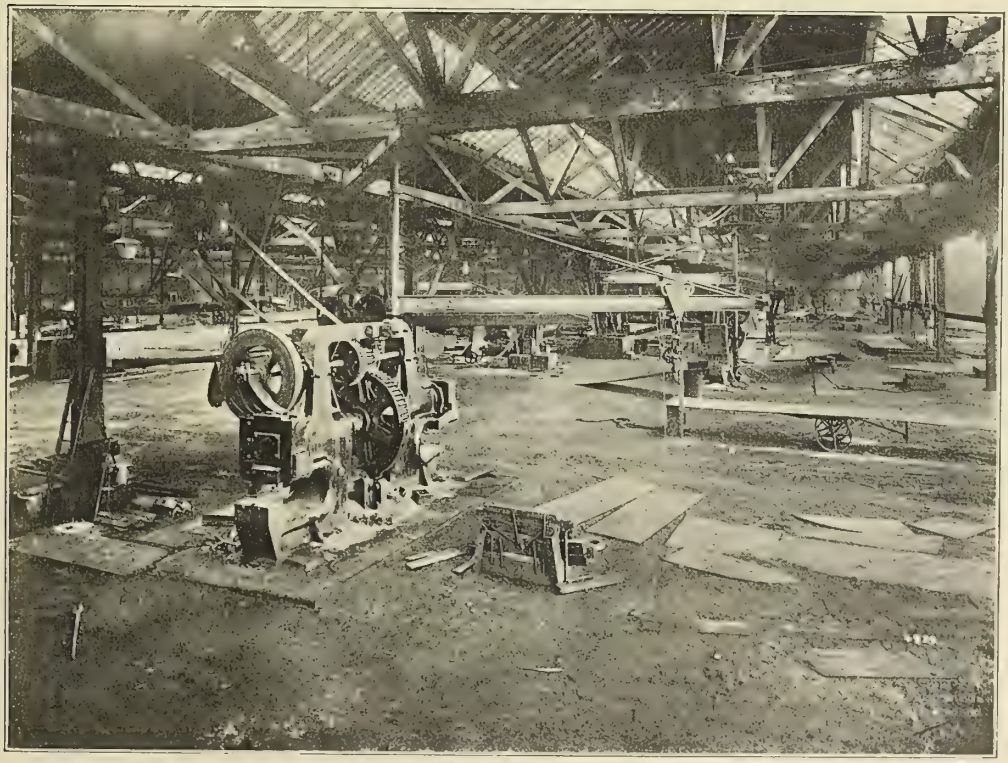


PLATE SHED.

VIEWS AT THE SHIPYARD OF ALEXANDER STEPHEN AND SONS, LTD., GOVAN, SCOTLAND.

TRIPLE-EXPANSION TWIN-SCREW PROPELLING ENGINES OF THE U. S. BATTLESHIPS CONNECTICUT AND LOUISIANA.

The latest battleships contracted for by the United States government are numbers 18 and 19, which have been named *Connecticut* and *Louisiana* respectively. The former one is to be laid down at the Brooklyn Navy Yard and the latter one is under construction at the Newport News Shipbuilding and Dry-Dock Company. As previously stated in these columns, it is the aim of the Navy Department to have all details of these ships identical, in order that a fair comparison may be made between the cost of navy-built vessels and those built by private contractors.

In preparing the plans for these battleships the Bureaus of Construction and Repair and of Steam Engineering have prepared the plans and specifications with the greatest care and detail in all particulars.

The propelling engines will be right and left hand, placed in water-tight compartments, separated by a middle-line bulkhead. The engines will be of the usual vertical, inverted, direct-acting, triple-expansion, four-cylinder type, the diameters of the cylinders of each engine being 32 1-2, 53, 61, and 61 inches, the stroke of all pistons 48 inches. With a pressure of 250 pounds of steam in the high-pressure cylinder, the engines are designed to make 120 revolutions per minute and indicate 16,500 horse power.

The arrangement of the cylinders from forward aft is, forward low-pressure, high-pressure, intermediate-pressure, and after low-pressure. The forward pair of cylinders have cranks opposite each other, as have also the second pair, the second pair being at right angles with the first; thus the sequence of cranks will be, high-pressure, intermediate-pressure, forward low-pressure, after low-pressure. This arrangement may be modified later if it is found that by so doing there will be less vibration of machinery. There will be one piston valve on the high-pressure cylinder and two on each of the intermediate and low-pressure cylinders, all valves being worked by Stephenson link motion. The engine bed plates will be of cast-steel supported on the keelson plates, and the framing will consist of forged-steel columns trussed by forged-steel staves. Hollow shafting is to be used throughout, and, with the piston rods, connecting rods, and other working parts, will be forged of open-hearth steel.

Each main condenser will have a cooling surface of about 10,375 square feet, measured on the outside of the tubes. For each condenser there will be an independent air pump of the double, vertical, single-acting type and a main centrifugal pump. There are four auxiliary condensers, one of 550 square feet in each engine room, and one of 950 square feet of cooling surface in each dynamo room for the exclusive use of the dynamo engines. All the auxiliary condensers are fitted with an air and circulating pump.

The boiler equipment consists of twelve water-tube boilers of the Babcock and Wilcox marine type, placed in six water-tight compartments. The total grate surface will be about 1,100 square feet and the total heating surface about 46,750 square feet. A system of forced draft is supplied by blowers discharging into the air-tight fire rooms, with two blowers for each boiler compartment.

There will be two main feed pumps, a fire and bilge pump, a hot-well pump, and a bilge pump driven from the forward end crank shaft in each engine room. An auxiliary feed pump will be placed in each boiler room. This list of auxiliaries includes ash hoists, turning engines, auxiliary pumps, refrigerating machinery, motors for workshop, distillers and evaporators, steam reversing gears, etc.

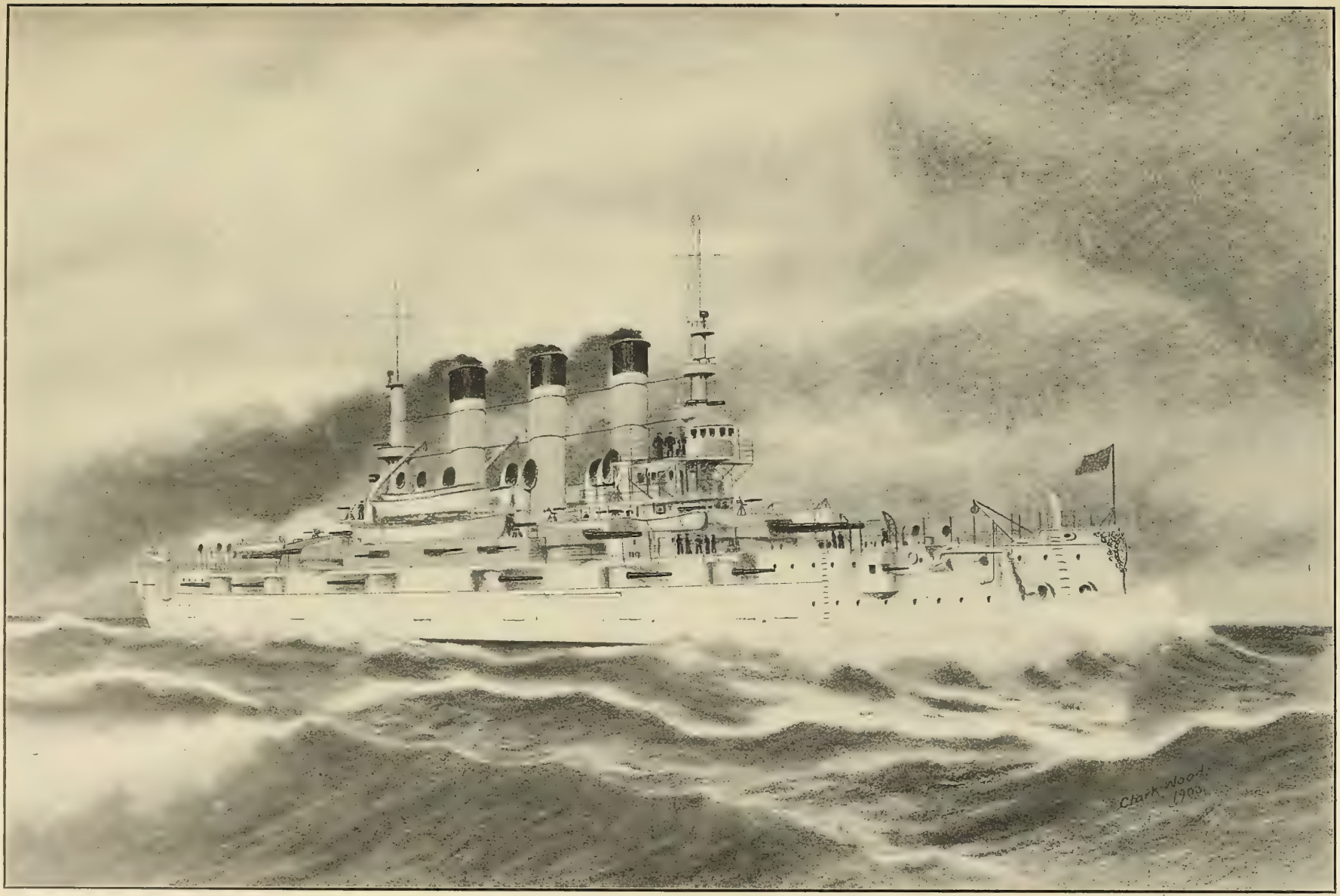
The cylinders are to be of close-grained cast-iron, and each cylinder and valve chest is to be fitted with a cast-iron liner. All the cylinders will be steam-jacketed round the working liners, and the intermediate- and low-pressure cylinders jacketed at both ends. The jacket steam will pass successively through the high-pressure, intermediate- and low-pressure jackets, with reducing valves on the two latter cylinders. An adjustable spring relief valve, 3 1-2 inches diameter, is fitted at each end of each cylinder. All cylinders and valves are drained. From the outboard side of each low-pressure valve chest there will be a 22 1-2-inch copper exhaust pipe leading to condenser. There will also be two receiver pipes on the outboard side connecting the high- and intermediate-pressure valve chests and 11 inches in diameter; from a 20-inch outlet on the outboard side of the intermediate chest a copper receiver pipe will lead with a 16 1-2-inch branch to each low-pressure valve chest, and each of these branches will again branch into two 11 1-2-inch

NAMB—Connecticut. NATIONALITY—American TYPE—Battleship.

BUILDER - Brooklyn Navy Yard. OWNER—United States.

Engines: Type.....four-cylinder, triple-expansion
Cylinder, diam.....32 1-2, 53, 61, 61 ins.
" stroke.....48 "
I. H. P., designed.....16,500
Revolutions, designed.....120
Cylinder walls, thickness H. P. ....1 7-8 ins.
" I. P.....1 7-16 "
" L. P.....1 1 4 "
Piston rods, outside diam.....7 1-4 "
Connecting rods,
Length between centers.....96 "
Diam. top..... 6 7-8 "
" bottom..... 8 "
Piston valves, diam. H. P.....17 1-2 "
" two I. P. and two L. P..19 "
Shafting, diam. crank.....16 1-2 ins.
Diam. crank pins,
17 1-2 by 19 ins. long
" thrust..15 1-2 and 15 3-4 ins.

Shafting, diam. line.....15 1-2 ins.
" stern tube and propeller.....16 1-2 "
" axial hole in all..... 9 1-2 "
Air pumps.....two 30 in. steam,
two 12 1-2 air by 20 in. stroke
Condensers, cooling surf., each 10,375 sq. ft.
Tubes.....4,878 tubes 18 B. W. G. 5-8 in. o. d.
Circulating pump.....265 revolutions,
12,000 gal. per minute
Boilers: Number of.....12
Type.....Babcock and Wilcox
H. S. total.....46,750 sq. ft.
G. S. total..... 1,100 " "
Working pressure.....265 lbs.
Length of grate.....6 ft. 9 ins.
H. S. ÷ G. S..... 42.5
I. H. P. ÷ G. S..... 2.83
.....15.0



NEW UNITED STATES BATTLESHIP CONNECTICUT AND CLASS.

Length on load water line, 450 ft.; Beam, extreme, 76 ft. 10 in.; Draft, mean, 24 ft. 6 in.; Displacement, 16,000 tons; Speed, 18 knots; Indicated horse power, 16 500. Batteries: Main, four 12-in. B.L.R., eight 8-in. B.L.R., twelve 7-in. B.L.R.; Secondary, twenty 3-in. R.F., twelve 3-pdr., eight 1-pdr., two 3-in. field, eight machine. Armor: Belt, top 11 to 4 in., bottom 9 to 4 in.; Turrets, 12, 8, and 6 ins.; Barbettes, 10, 6, and 4 ins.

pipes connecting near the top and bottom of the low-pressure chests.

The high-pressure piston and followers are of cast-iron; the other pistons will be of cast-steel with wrought-iron followers. The design of these parts is shown in the drawing. The piston rods are hollow, with a 4 3-8-inch hole in the low-pressure rods, a 3-inch hole in the intermediate, and 1 1-2 inch in the high pressure. These holes are reduced at the crosshead ends. The outside diameter of all rods is 7 1-4 inches. The crosshead pins are to be 9 1-2 inches diameter. The forged-steel crosshead is of the slipper type, with bearing surface faced with white metal, and 21 by 27 inches on the go-ahead side. The connecting rods are also hollow, the bores being of different diameters, and they are forked at the upper end for spanning the crosshead; brasses are accurately fitted at either end, lined with white metal. The piston valves are single-ported and fitted with cast-iron packing rings and forged-steel followers. Each valve is fitted with a balance piston. The eccentrics are made in two parts, the larger part being of cast-iron, the smaller of forged-steel, and both will be rabbetted at each side for flanges of the eccentric straps. The backing eccentrics will be securely keyed to the shaft and each go-ahead eccentric will be fitted with a key and adjusting piece. The straps will be of composition and in two parts. The valve stems and eccentric rods are of high-grade forgings.

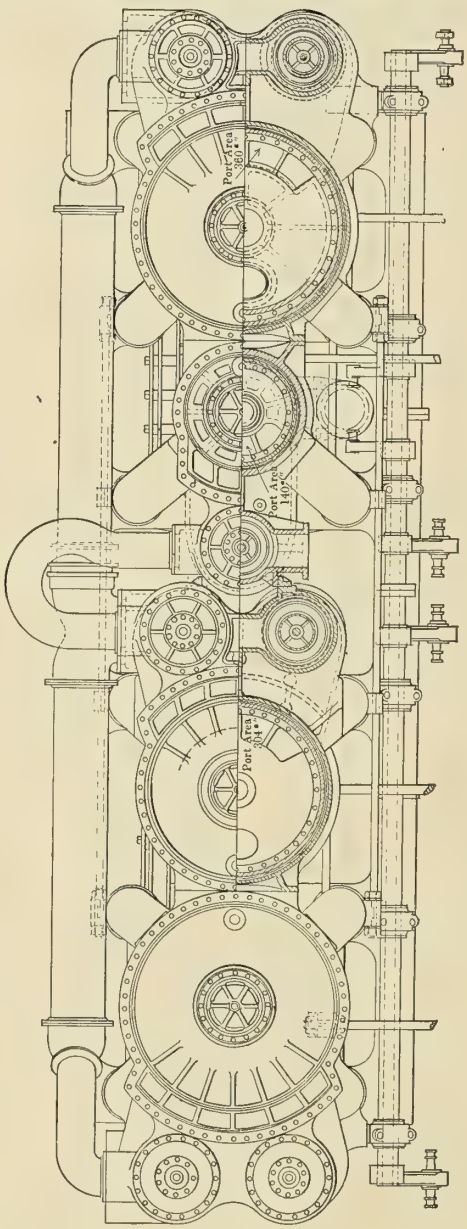
The cylinders for each engine will be supported by 6 front and 6 back columns, 5 1-2 inches diameter, of design as shown in the drawing, and with suitable diagonal braces. The crosshead guides will be of cast-iron, with water circulation, and the slipper backing guides will be of cast-steel properly secured. The bed plate is of cast-steel, with longitudinal and cross girders of I section. All shafting is of "Class A" forging, with an axial hole bored from end to end; the diameters are given in the accompanying table. The crank shaft will be in two sections, coupled together; the thrust shafts have thirteen collars; the stern tube shafts will be covered by composition water-tight casting made in sections, shrunk and pinned on; a casing will also be fitted to the propeller shaft. The screw propellers are to be of manganese bronze, left-handed on the starboard engine and right-handed on the port engine. The reversing gear for each engine will consist of a steam cylinder and an oil-controlling cylinder secured to the high-pressure cylinder casing. The reversing shafts are carried along the inboard side of each engine, with bearings secured to the engine column and low-pressure valve chests. The floors on the inboard side of each engine, opposite the high and intermediate cylinders, will serve as working platforms. A very complete system of lubrication is specified, both automatic and sight-feed lubricators being used.

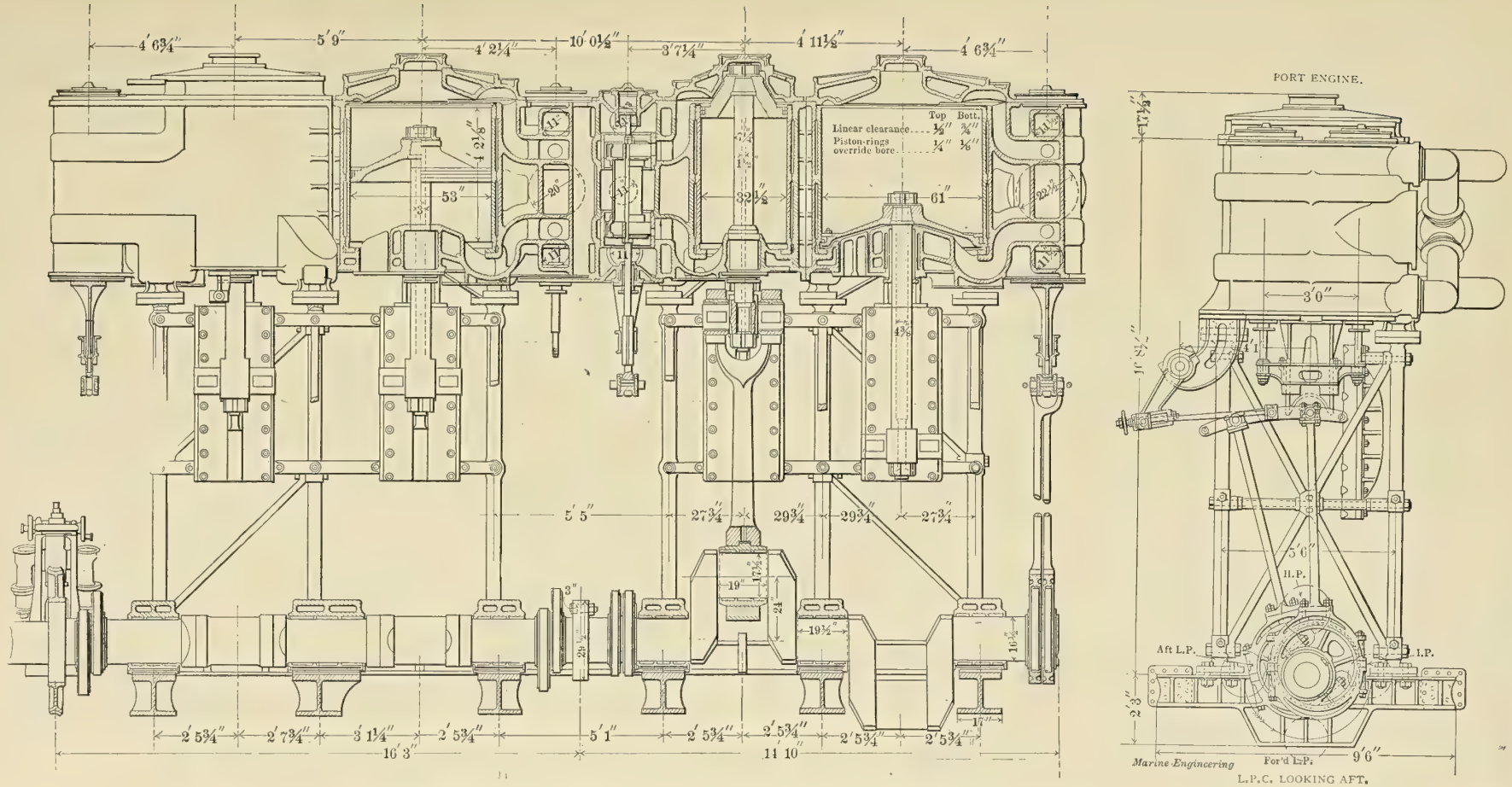
Names of Masts.—In view of the discussion as to the names of the masts of six- and seven-masted schooners, the captains of these vessels have agreed to name the masts as follows: The first three masts will be called by the names that have always been applied to them, namely, fore, main, and mizzen, and the aftermost mast shall be called the spanker. When there are more than four masts the names of the intervening masts will be termed No. 4, No. 5, No. 6, etc., numbered from the bow.

German Shipbuilding.

The United States Consular Reports for March contain an interesting sketch of the progress of shipbuilding on the river Weser in Germany. The first of the record-breaking ships turned out by Germany was the *Kaiser Wilhelm der Grosse,* which was followed by the *Deutschland* in 1900, the *Kronprinz* in 1901, and the *Kaiser Wilhelm II.,* now about to make her maiden trip across the Atlantic. Thirty years ago there were only seven shipyards in Germany; to-day there are about sixty, large and small. Five of these are located on the banks of the river Weser between Bremen and Bremerhaven. While they are not equal to building the largest types of merchant and war vessels, they are fully equipped for turning out thoroughly modern vessels of every description. All these concerns are doing prosperous business and paying dividends of between 10 and 12 per cent.

The Weser Aktiengesellschaft is now building new yards covering about six acres of land. The Vulcan





FOUR-CYLINDER TRIPLE-EXPANSION ENGINES OF THE NEW BATTLESHIPS CONNECTICUT AND LOUISIANA.

Shipbuilding Company has a modern plant, and, while it cannot build the large ships which are turned out of the Stettin yard of the same name, it has launched six ships during the last six months and has seventeen others under construction. The Tecklanburg Company, at Bremerhaven, has been occupied to its fullest capacity during the entire year, having under construction six twin-screw freight and passenger steamers and two large sailing vessels. This firm is famous for building large sailing craft; the largest in the world, the *Preussen,* was completed a few weeks ago. This company declared a dividend of 20 per cent. at the close of its last business year. The Rickmers Rhederei and Schiffbau Company, at Bremerhaven, has three small steamers under construction. The G. Seebeck Company, Bremerhaven, declared a dividend of 10 per cent. upon the closing of its seventh business year. The chief output of the yard has been in steamers for fishing on the high seas. Two passenger and freight steamers were also built for the North German Lloyd Company, making a total of 192 ships turned out since its foundation.

Thus it is seen that Germany, while undergoing depression in many commercial lines, has been very active in shipbuilding. This is specially noteworthy, as Germany is not geographically a strictly maritime nation and is dependent on other countries for the raw materials that enter largely into the making of the ship.

FURTHER NOTES ON THE INFLUENCE OF SHOAL WATER UPON THE SPEED OF SHIPS.

BY ALFRED E. LÜDERS.

The purpose of this article is to draw attention to a few experiments, made by various people, that bear out, more or less, the conclusion to be formed from a study of Captain Rasmussen's investigations as set forth in the November number of Marine Engineering.

The experiments, aside from the deductions to be made from them regarding the influence of shoal water upon speed of vessels, are in themselves of interest on account of the unique manner in which the investigators conducted the trials in an effort to get at the fundamental principles underlying the subject. The experiments in question and the subsequent discussions are to be found set forth at some length in various papers of the British Institute of Naval Architects.

The following remarks are taken to some extent from these papers, and back numbers of other publications were freely consulted in an endeavor to exhaust the subject as nearly as possible.

In 1900 Major Rota, R. I. N., conducted a series of model experiments in the model tank at the Royal Dockyard of Spezia, Italy. In these trials the tank, which ordinarily had a depth of ten feet of water, was shoaled by means of an adjustable wooden flooring extending a considerable length of the tank, and by the simple expedient of raising or lowering this platform the depth of water could be regulated to suit.

In all, five models were tested, the resistance, trim, speed, etc., being tabulated in the usual manner at the various depths of water. From these data it was possible to apply the results to full-size ships by the well-known laws of comparison.

The figures obtained by the trials of models were put in the usual form of speed and resistance curves, the curves for the various depths being superimposed to facilitate comparison. In Fig. 1 model No. 5 is shown, as this is the only boat that was speeded at an abnormal rate for the various depths of water; here the curves show the characteristic hump at what we have termed the "critical speed." It will be noticed how, in the case of extremely shallow water, the resistance falls below the normal resistance curve when the vessel is pushed beyond the "critical speed."

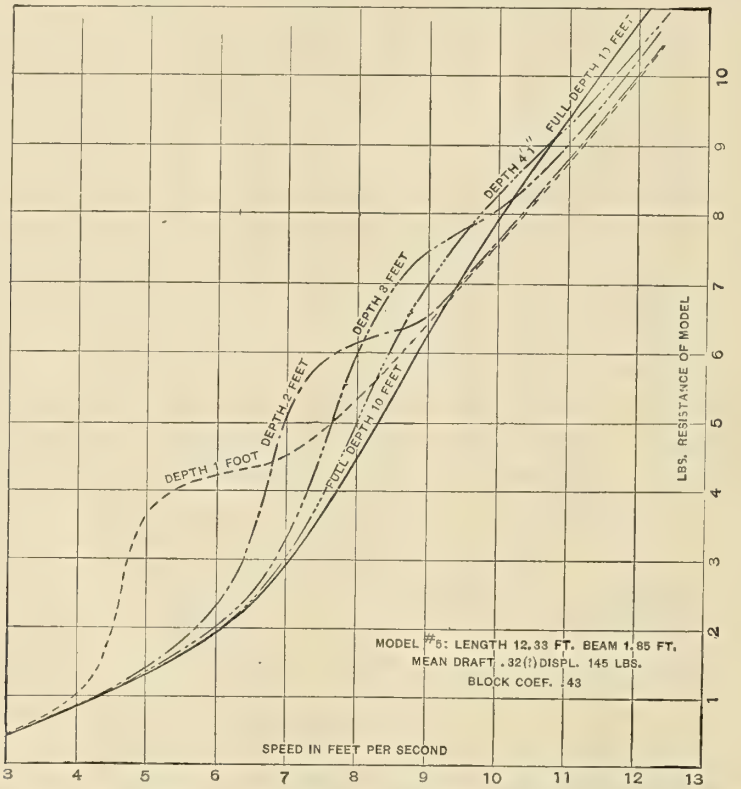

DEPTH 1 FOOT
DEPTH 2 FEET
DEPTH 3 FEET
DEPTH 4 "
FULL DEPTH 10 FEET
FULL DEPTH 13 FEET
MODEL #5: LENGTH 12.33 FT. BEAM 1.85 FT.
MEAN DRAFT .32(f) DISPL. 145 LBS.
BLOCK COEF. .43
SPEED IN FEET PER SECOND
LBS. RESISTANCE OF MODEL
3 4 5 6 7 8 9 10 11 12 13
1 2 3 4 5 6 7 8 9 10

FIG. 1.—RESISTANCE AND SPEED CURVES OF MODEL 5, IN DIFFERENT DEPTHS OF WATER.

These curves appeared, in Major Rota's paper, in the metric system, and have been, for the sake of convenience, adjusted to conform to the foot and pounds standard. In the trials just referred to, the idea was not to determine the critical speed, but rather to find a maximum speed, at the various depths, at which resistance would be at a minimum.

In Fig. 2, which is a set of cross curves of Fig. 1, the locus of minimum resistance is shown, and from that Major Rota calculated that for the following speeds, for a 150-ton torpedo boat on the lines of model No. 5, it would take the following depths of water:

Speed in knots per Hour.	Depth of Water in Feet, Corresponding to Minimum Resistance.
12	43
14	53
16	76
18	85
20	85
22	20 (about)
24	20 "
26	20 "
28	20 "
30	20 "

The decrease of resistance at high speed is attributed by this writer to variation of trim, which is sensibly different from that observed in deep water.

In the discussion that followed the reading of Major Rota's paper, it was brought out that Mr. Archibald Denny had had recourse to model experiments in his tank at Dumbarton, with the idea of ascertaining whether or not his firm could guarantee certain speeds in shallow rivers. His conclusions were that they certainly would not do so. As an explanation for holding such opinions, he laid considerable stress upon the instability of the results of the trials; runs taken within five minutes of each other showed variations of as much as 15 per cent. resistance for the same speeds.

The water in the tank was only 1.252 feet deep during the shallow-water trials, a false flooring having been fitted for about 150 feet, in much the same manner as had been done by Major Rota. When the model was towed at extreme speeds, the flooring of tank was laid bare of water for some distance behind model; the consequent change of trim is apparent from the curves. As a check on the formula:

$$V^2 = gh,$$

where V = speed of vessel in feet per second,
g = acceleration due to gravity, or 32.16,
h = depth of water at which speed is critical.

If we take the case of Mr. Denny's 12-foot model, then from the curves we see that

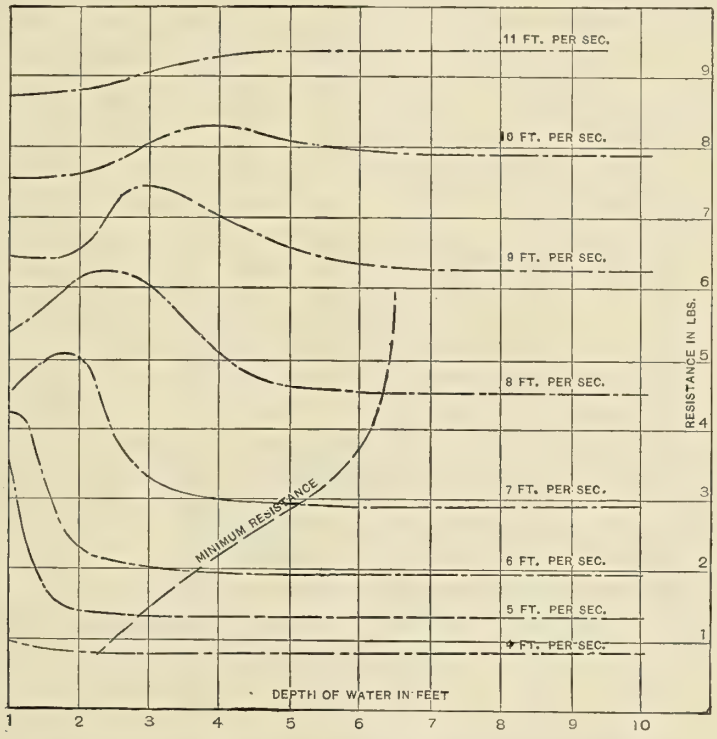

11 FT. PER SEC.
10 FT. PER SEC.
9 FT. PER SEC.
8 FT. PER SEC.
7 FT. PER SEC.
6 FT. PER SEC.
5 FT. PER SEC.
4 FT. PER SEC.
MINIMUM RESISTANCE
RESISTANCE IN LBS.
DEPTH OF WATER IN FEET
1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9

FIG. 2.—RESISTANCE AND SPEED CURVES OF MODEL AT DIFFERENT SPEEDS.

In the experiments on the Danish vessels Captain Rasmussen also spoke of this instability; he noticed that when the ship was running at speeds close to the value $V = \sqrt{gh}$, the putting of the helm over was sufficient to cause a drop of several knots in the vessel's speed; quite some time being required before the vessel reached the speed V after helm had been brought amidships.

To return to Mr. Denny's investigation, the vessel for which the speed guarantee had been requested was a barge 200 feet long by 27 feet beam. The model corresponding to this ship was 12 feet long, 1.62 feet beam, .27 foot draft, and had a block coefficient of .837. By referring to Fig. 3, we see the speed, resistance, and trim curves plotted; the shaded portion between the two curves is the difference in two similar trials and represents graphically the above-mentioned instability. Here again we have an example of the resistance in shallow water being less after critical speed had been passed than that met with in greater depths.

$$V = \frac{380}{60} = 6.33 \text{ feet per second.}$$

By substituting and solving for h we have

$$h = \frac{(6.33)^2}{32.16} = 1.246 \text{ feet,}$$

which is .006 foot less than the actual depth of water in tank.

From the various trials that have been conducted, it is obvious that we can ascertain the resistance of a vessel driven at speeds far beyond the critical speed, from which it is only natural to suppose that put sufficient power in the ship and the desired speed will be reached. This is quite true in general, as stated in the earlier article; but as abnormal speeds beget abnormal conditions, we might find that in the case of a paddle steamer the wheels would have to work alternately in the hollow or on the crest of the wave as the speed fluctuates, while in a screw vessel the water might disappear entirely from under the stern; propulsion under such circumstances would be manifestly impossible.

As practical examples of the effect of shoal water upon the speed of vessels, the following are cited:

The British Admiralty tested two torpedo gunboats of exactly the same design; one was tried at half and the other at low tide, the corresponding depths being respectively 51 and 42 feet. The same power was developed in each boat, but the vessel that was tried in deep water attained a speed of 17 1-2 knots, while the other boat made a half knot less in the shallower water.

Another vessel of same type, which had trials at both high and low water, averaged over the high-water run 17.8 knots with 2,800 I. H. P., whereas during low water 16.9 knots were obtained with an expenditure of 2,600 I. H. P.; here the loss due to shoal water was a half knot, after allowing for the difference in power.

The *Edgar,* a British twin-screw, first-class cruiser, 7,350 tons displacement, in 12 fathoms of water required 13,260 I. H. P. to make 20 1-4 knots, while in 30 fathoms 21 knots were reached with 12,550 I. H. P., a gain of three-quarters of a knot with 710 less horse power; in other words, the *Edgar* would attain 20 1-4 knots with 1,500 I. H. P. less than that required in the shoal water.

The *Columbia,* a twin-screw transatlantic vessel of the Hamburg-American line, during her trial in 8 fathoms of water, made 19 1-4 knots, while in her regular passage 19 knots are averaged, 19.5 knots being frequently reached.

The above cases, although by no means extreme, all point out the necessity of having sufficient depth of water to avoid approach to the critical speed and thereby incurring undue resistance.

Mr. Froude has noted some experiments taken quite a number of years ago, in which it was found that the shoaling of the water increased the resistance only from 3 to 5 per cent. This was deduced from model experiments in the tank at Torquay, the models, however, being run at a comparatively moderate speed, 16 knots being about the limit for vessels at that time.

A rather interesting feature in the case of vessels going at high speed, where the water is limited in depth, is the tendency of the vessel to sink bodily. In one instance the decrease of freeboard was very noticeable when the ship was speeding, but it was thought to be an optical illusion until careful measurements were made and the actual decrease of freeboard was established as a fact. The boat in question was employed as a scout.

Stern-wheel steamers often ground when under way in water that is of ample depth for vessels when at rest. To get around this difficulty when this type of vessel finds it necessary to go over shallows in a river, it frequently has recourse to backing through them, and thus avoids grounding. The explanation of this is very simple: when going ahead in the ordinary manner, the stern wheel accelerates the flow of water from under the after end of vessel, there is a loss of buoyancy and the stern sinks enough to touch bottom; when the vessel is turned and backed the wheel again accelerates the flow of water, but this time it is forced under the boat, buoyancy being thereby gained, and the vessel floats high enough to obviate all danger of grounding.

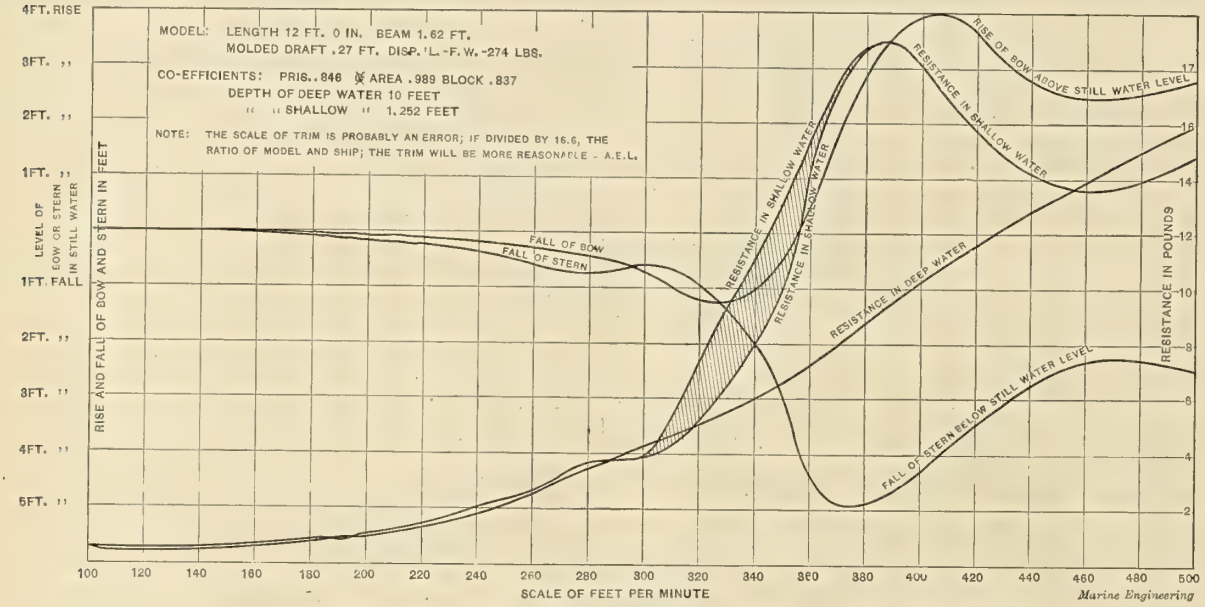

MODEL: LENGTH 12 FT. 0 IN. BEAM 1.62 FT.
MOLDED DRAFT .27 FT. DISP. L.-F. W. -274 LBS.
CO-EFFICIENTS: PRIS. .846 & AREA .989 BLOCK .837
DEPTH OF DEEP WATER 10 FEET
" " SHALLOW " 1.252 FEET
NOTE: THE SCALE OF TRIM IS PROBABLY AN ERROR; IF DIVIDED BY 16.6, THE RATIO OF MODEL AND SHIP; THE TRIM WILL BE MORE REASONABLE - A.E.L.
4FT. RISE
3FT. ,,
2FT. ,,
1FT. ,,
LEVEL OF BOW OR STERN IN STILL WATER
1FT. FALL
2FT. ,,
3FT. ,,
4FT. ,,
5FT. ,,
RISE AND FALL OF BOW AND STERN IN FEET
FALL OF BOW
FALL OF STERN
RESISTANCE IN SHALLOW WATER
RESISTANCE IN SHALLOW WATER
RESISTANCE IN DEEP WATER
RISE OF BOW ABOVE STILL WATER LEVEL
RESISTANCE IN SHALLOW WATER
FALL OF STERN BELOW STILL WATER LEVEL
RESISTANCE IN POUNDS
17
16
14
12
10
8
6
4
2
100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500
SCALE OF FEET PER MINUTE
Marine Engineering

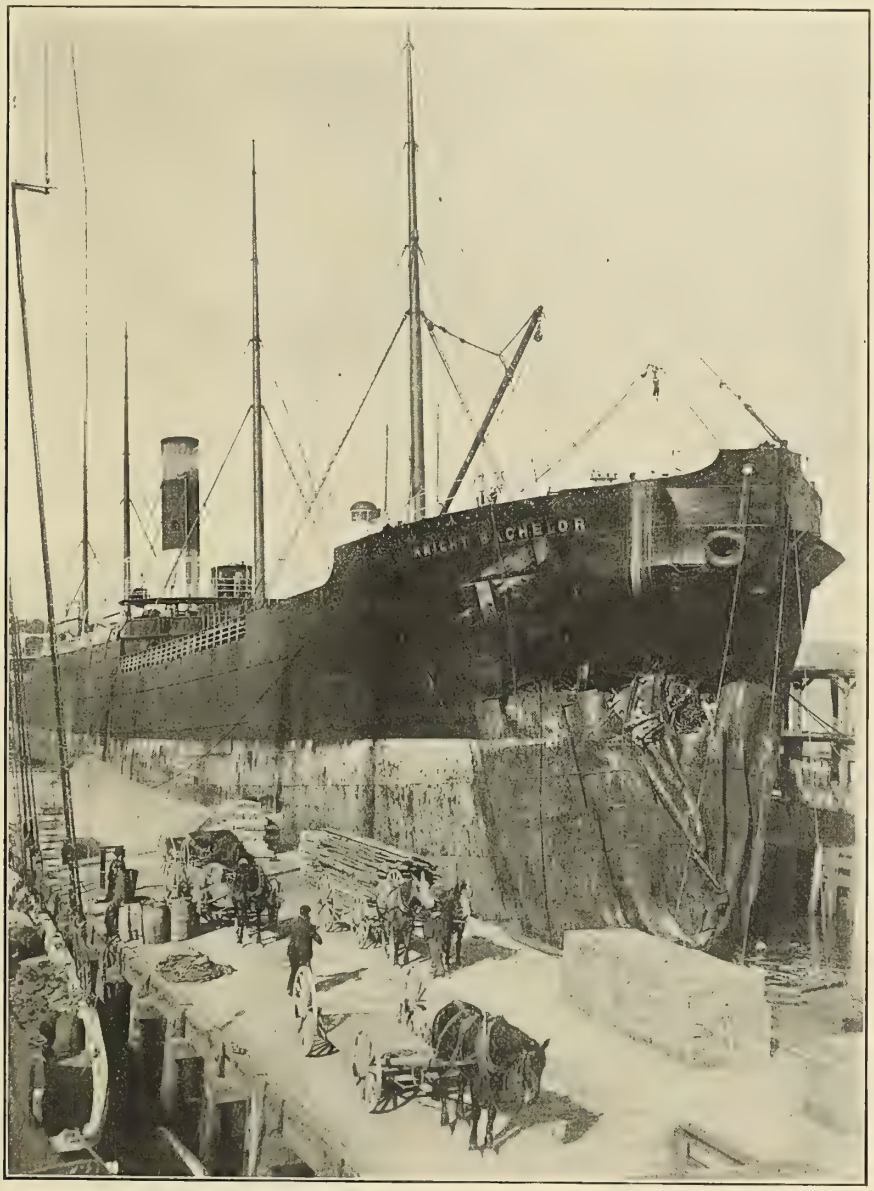
FIG. 3.—COMPARISON OF RESISTANCE IN SHALLOW AND DEEP WATER OF A BARGE 200 FEET LONG, 27 FEET BEAM, AS OBTAINED BY MODEL EXPERIMENT.

As a concluding example to the general phenomena, and one that may prove of interest to launch owners, attention is drawn to the Thames launch *Boadicea,* a Thornycroft boat of approximately 35 feet length, 5 feet 6 inches beam, and a draft of 10 inches; this boat was fitted with a turbine propeller 16 inches in diameter working in a tunnel at stern of boat. This craft, which had a speed of 15.8 miles per hour, has the distinction of running more swiftly and easily when crossing the mud flats at low tide, with only an inch or two under her bottom, than when in the deep channel. Here we see that for a probable depth of, say, 1 foot of water the vessel is at the critical speed when making about 3 1-3 miles per hour, so it is only reasonable to expect that when the speed of 15 miles per hour is approached the resistance should be considerably less than met with in deep water. This proves conclusively the possibility of high speed in shoal water.

Bad Head-On Collision.

The accompanying illustration of the new, fine English ship *Knight Bachelor* shows how badly her bows were broken in by colliding with an iceberg off the banks of Newfoundland several months ago. Navigation of these waters is extremely dangerous in the spring because of the floating ice and icebergs. To add to the dangers are the banks of fog which hover over these waters for half the days of the year. Fog is almost always present in the neighborhood of icebergs, thus increasing the risk of collision.

Fortunately, the *Knight Bachelor* sustained the greatest damage above the water line and was kept afloat by the presence of the forward collision bulkhead. She proceeded under her own steam to Halifax, where repairs have since been made. The ship is 450 feet long, 52 feet beam, 31 feet deep, and is of 6,394 gross tons. She was built at Glasgow in 1894.



STEAMER KNIGHT BACHELOR AFTER COLLIDING WITH AN ICEBERG.

Reorganization of the William R. Trigg Company.

A prospectus of the reorganization plan of the William R. Trigg Company has been distributed to stockholders and creditors of the company. The reorganization is being undertaken by Joseph H. Hoadley, of New York, N. Y., in accordance with the recommendation of the Reorganization Committee. The creditors are to receive in settlement of their claims, not including interest, 33 1-3 per cent. in cash and the balance, or 66 2-3 per cent., in the common stock of the new company. The second mortgage of $1,000,000, the issue of $755,000 preferred stock, and $1,155,000 of common stock, are to be exchanged for the new securities. The new corporation will have a capital of $1,500,000 6 per cent. accumulative preferred stock with shares at par value $1,000 each, and $5,000,000 common stock with shares at par value $100 each. The company may also issue $1,000,000 worth of thirty-year 4 per cent. gold bonds.

Marine Engineering

Published Monthly by

MARINE ENGINEERING,
INCORPORATED

309 Broadway - - - New York.

H. L. ALDRICH, President and Treasurer.

PROF. W. F. DURAND, Advisory Editor.

FREDERICK D. HERBERT, Editor.
GEORGE SLATE, Advertising Representative.

Branch Offices.

Philadelphia, Pa., Mach'y Dept., The Bourse, S. W. Anness.
Boston, Mass., 170 Summer St., S. I. Carpenter.

TERMS OF SUBSCRIPTION.

	Per Year.	Per Copy.
United States, Canada and Mexico	$2.00	20 cents
Other countries in Postal Union	2.50	25 cents

Entered at New York Post Office as second-class matter.

Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

IF the last Congress failed to meet our expectations in some directions, it spoke in no uncertain terms at least regarding the continued upbuilding of the navy. Five new battleships are provided for, three of which will undoubtedly be duplicates of the *Connecticut* and *Louisiana*, of 16,000 tons each, our heaviest and largest ships yet designed or contemplated. The other two are to be of about 13,000 tons each, a size intermediate between the new *Maine* and class and the *Virginia* and class. There should be no delay in making a start on the three larger ships, at least. The plans of the *Connecticut* and *Louisiana* are immediately available, and such minor changes as may be considered necessary should only take a few weeks' time. The plans will certainly be changed in minor ways during the progress of construction, and no better start could probably be made than to take the plans for this class substantially as they are and proceed with the call for bids. If there is one thing about our naval construction regarding which we cannot take pride, it is the length of time required by our yards between the signing of the contract and the delivery of the completed ship. Measured in years, as it is, it seems impossible to understand where all the time can have gone, or how possibly such a period can have been necessary for the preparation and assembling of the few thousand tons of material which constitute even a battleship.

Looked at in detail, and with the builders' statements regarding delays from all manner of causes —lack of material, lack of armor, lack of equipment and failure on the part of various subcontractors for auxiliaries and equipment to deliver as agreed, changes in the plans, excessively rigid inspection, labor troubles, etc., etc.—one can see where at least a part of the time has gone. Giving the builder full benefit for these various causes of delay, it still remains a fact that the time seems too long. Without attempting, however, any apportionment of the responsibility for delays or for the length of time required, it is very sure that it is too long, and no one feature of our naval construction is perhaps more deserving of careful study from both the engineering and the business point of view. All shipbuilders realize that the saving of time is a matter depending on one quite as much as on the other.

In a word, here is the situation. A given ship requires, let us say, 8,000 tons of structural material to be prepared and assembled. The actual work drags over two or three years or more. The time really occupied in the work that finally counts, and reduced to the basis of full gangs of workmen constantly employed, is probably not much, if any, over half this. In other words, there is no mechanical hindrance to the building of the ship in perhaps half the time actually required. Then why not do it, or, at least, make some nearer approach to such a rate of construction?

The answer involves the whole situation, technical and business, and in recent years has attracted the attention of some of our ablest Naval Constructors on the one hand, and of our most experienced and capable shipbuilders and engineers on the other. We shall attempt to offer here only two or three suggestions, perhaps self-evident in themselves, but, nevertheless, not always appreciated at their full importance.

In the first place, there should be the clearest possible understanding between the buyer and the builder as to just what is to be furnished by the latter, and, once the contract made, the presumption should be decidedly against any change. It is not to be assumed, of course, that no changes should be made where marked improvement can clearly be effected, but the burden of proof should

be clearly on the side proposing the change, with the presumption against it. It will be better to get the ship somewhere nearly on time rather than have her completion delayed for changes of uncertain value. Again, in all government specifications the phrases "as approved," or "of approved design," are fruitful sources of possible delay. It is not always possible in advance to specify the exact make or quality of each item of equipment, or of certain structural arrangements dependent on special equipment, and some such phrase seems a practical necessity. Here again, in drawing specifications, the presumption should always be against such a phrase, unless absolutely necessary. If so, the agreement involved should be made at the earliest possible moment, and long in advance of the period of use of the item concerned, so that no delay may be caused when the time of installation is at hand. Perhaps the most serious delays are caused by the difficulty in obtaining structural material promptly, especially when the shapes and dimensions are somewhat unusual, as may frequently occur in government work. Here something might, perhaps, be done by a more careful scrutiny of the scantlings involved, by an elimination of odd or unusual sizes and shapes, and by a more pronounced attempt to meet the trade condition as viewed by the steel maker in his efforts to keep up with his orders. Here the builder meets with the difficulty which affects all his construction, mercantile as well as naval. It is a difficulty the more serious in that its removal lies, in great measure, outside his power. Probably the most that the shipbuilder can do seems to be to anticipate his needs to the furthest possible extent, and to use all his powers of persuasion with the maker to give him his material on time and, to some extent at least, in the order desired. In the shipyard itself the question of speed depends on too many factors to admit of any discussion in detail whatever. Generally speaking, however, and having interest charges, insurance, etc., in view, it will be found cheaper in the end for the builder, as well as better for the government, to operate all the men who can profitably be employed on the material and without blocking each other's way. In other words, the effort should be made to so lay out and arrange the work as to admit of the maximum number of points of attack at one time, and to follow up the work in this manner by the employment of a man wherever a point of attack is open. In the shops, likewise, the ideal should be to keep every wheel turning and every tool in operation throughout the largest possible fraction of the day. An idle tool is earning nothing, and, on the contrary, is, through its fixed charges, a source of constant expense. Special tools cannot be kept so occupied, but by suitable study something could usually be done to increase the rate of output by keeping standard tools, such as punches and shears, busy in one way or another for the maximum possible number of hours per day. In other words, the presumption should always be against an idle tool; it should require an excuse and a good one.

The importance of effecting a marked increase of constructive speed in our shipyards, and especially in government work, can scarcely be exaggerated, and the accomplishment of such an end is certainly worthy of the most painstaking study and effort on the part of all parties concerned. Such study, with a spirit of co-operation, actuated by a common desire to attain this end, would certainly accomplish much. Is it not worth renewed and most serious attention on the part of both government and private builder?

INTEREST in the water-tube boiler question is still active. In Great Britain the "Boiler Committee" is occupied in further experiments, of which we learn the results from an occasional Parliamentary paper or from the public press. The latest paper deals with experiments carried out at various times in 1901 and 1902, and chiefly on boilers of the Niclausse and Babcock and Wilcox types. The results show marked improvement between the earlier and later types of these boilers, especially in the case of the latter. Difference in the conditions makes a comparison between the two types difficult. In the United States we are engaged in the navy in accumulating still further evidence regarding the various types, the results of which are published in full in the successive numbers of the *Journal of the Society of Naval Engineers.* The last issue, recently to hand, contains articles on the performance of the Babcock and Wilcox boilers of the *Marietta;* on the contract trials of the monitors *Wyoming* and *Nevada,* the former fitted with Babcock and Wilcox boilers, and the latter with Niclausse; on the contract trials of the destroyer *Stewart,* fitted with Seabury boilers, and a valuable general discussion of the "Naval Boiler Problem." We would commend these articles to all who are interested in the study of this problem from the modern standpoint of actual trial and experience.

United States Rules for Boilers.

Editor Marine Engineering:

It is a very easy matter for some people to find fault, then stop and not point out the remedy. It is also easy to misrepresent fact, not always done intentionally, perhaps, but sometimes thoughtlessly or on hearsay evidence. Therefore I must take issue with your correspondent "H. L. E." in his communication printed on page 159 of your March number (entitled "United States Rules for Boilers") regarding the Board of Supervising Inspectors' revival of an old rule, referred to by him as a "dead-letter law (Sec. 5, Page 22)," viz.: "Where flat surfaces exist, the inspector must satisfy himself that the spacing and distance apart of the bracing and all other parts of the boiler are so arranged that all will be of not less strength than the shell."

I have not looked up the matter far enough back to be able to state when it was first adopted or incorporated in the rules, but I find it is required by Sec. 4433 United States Revised Statutes. I also find it in the Rules and Regulations as far back as those issued in 1883, and I fail to find that it has ever been repealed. It is printed in every copy in my possession, and I have them for almost every year since the date mentioned. It will also be found in last paragraph of Sec. 6, page 25, of Rules and Regulations of 1902. I wish, therefore, H. L. E. would inform me when it was repealed and when revived.

It is a well-known fact among engineers, boilermakers, and others that there must be some established basis for the strength of a boiler. On general safe principles, then, all other parts and elements must conform in strength to that basis, and I am unable to see the force of his objection to the rule, unless he wants to make the seam the basis of calculation in place of the shell. If such is the case, what is to be gained? Just one of two things—either a greater factor of safety in the seam or a slightly reduced thickness in the shell, because all other parts of the structure must of necessity remain the same for the stated pressure. Practically the same object can be attained by adding to the present rule a minimum strength for the seam. If, for a given thickness, the factor of safety is to remain the same, and the allowable pressure increased according to strength of seam, then furnaces, staying, and all other parts must conform in strength to the increased pressure so allowed. This will add to the weight and cost quite as much as in the case cited by him, when analyzed and brought down to fact. His comparison is made by criticising a former reply in your January number, where the question and conditions were widely different from usual practice, and comparing it with United States rules, viz.: A boiler 12 feet diameter, material 60,000 T. S., strength of joint 80 per cent., factor of safety 4 1-2 with 1-16 inch added for corrosion.

He says: "Therefore in Q. 120, if a boiler 12 feet diameter, 60,000 T. S., and double-riveted, be given a shell 1 1-16 inch thick, the calculation by U. S. rules will give 177 pounds as the working pressure; and furnaces, stays, and all other parts will have to be designed for 177 pounds, even if it is desired to carry only 150 pounds working pressure. Of course the increase in size and weight will increase cost." Again: "U. S. rules for double riveting practically makes 5 the factor of safety in this case, and the shell thickness would then figure only 0.9 inch, omitting the 1-16 inch added for corrosion. The addition for corrosion will, according to U. S. rules, incur a *severe penalty*," etc.

In reply to this criticism, the calculations of H. L. E. for allowable pressure on the thicknesses of plate cited are correct, but the figures are misleading, inasmuch as he quotes 1.0625 inch thick in the case of the boiler having 1-16 inch added for corrosion, and leaves the 1-16 inch off in the other case. And again, he cannot obtain 80 per cent. strength of seam with double riveting in 1 1-6-inch plate. Hence the joint must be butt-strapped and triple-riveted.

Referring to a boiler of the dimensions stated and for 150 pounds working pressure, under U. S. rules the *severe penalty* alluded to by him for adding 1-16 to 0.9 inch will amount to just 10 pounds per square inch, making for a boiler .9625 inch thick 160 pounds working pressure. Hence the furnaces, staying, and all other parts of the structure would only have to conform to that of 160 pounds. This extra 10 pounds over the required pressure of 150 will not add very much to weight and cost; and if the person having it built desires a larger factor of safety than the rules require, he should have it in all the elements of the structure.

Under present practice multiple-riveted seams are not acceptable under 70 per cent. in any and all of their elements. In such case, then, by present rule, the factor of safety is 3 1-2 on the seam. If we are to consider the joint at 80 per cent., then the factor of safety is 4 for the joint, but all other parts will remain the same and have the same relation to the shell as before; hence no extra weight or cost. On the other hand, if the factor of safety remains 3 1-2, based on strength of seam, the allowable pressure will be increased to 171 pounds, and all other parts must also be increased in like ratio, adding to both weight and cost. Of these two conditions, I prefer the extra strength of seam.

For good tight work under high pressures, double-riveted lap joints are seldom over 72 per cent. Where double butt straps and triple-riveted joints are made in heavy plate, with the two inside rows of rivets in single pitch and double shear, and the outside row in double pitch and single shear, it is quite practicable to obtain 80 and even 85 per cent. for the joint. To this extra factor of safety on heavy plate, with the high pressures of steam of present-day practice, I can see no objection. Percentage strength of seam, if obtained with so great a pitch as to allow of leaky joints, must be avoided.

The requirements for seams of marine boilers are that all rivet holes shall be drilled. The shell is made the measure of strength for all other parts, and with a longitudinal seam having a minimum strength of 70 per cent. the factor of safety is 3 1-2 on the seam. Its strength may be increased by multiple riveting, but this does not in any way change the conditions or requirements regarding other parts of the structure; hence the rule is a simple one.

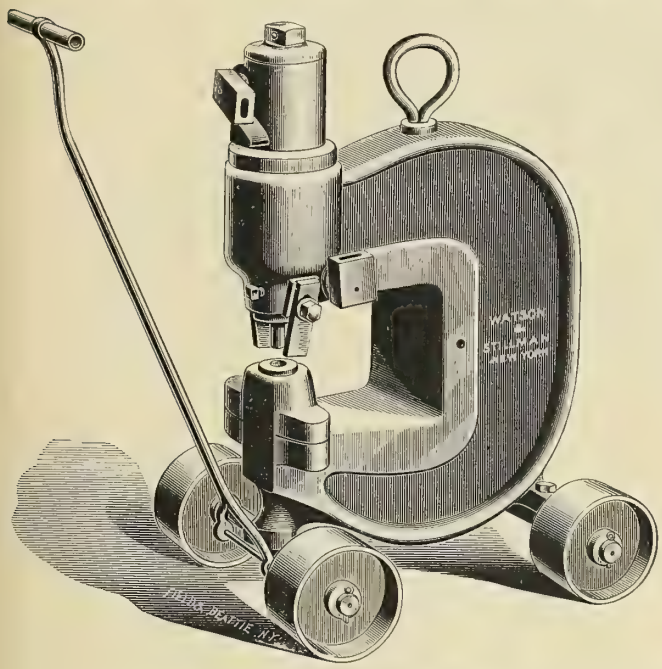
R. C.

Shamrock III.—As an omen of good luck, Sir Thomas Lipton's third challenger for the America's Cup was launched on St. Patrick's day, March 17, from the yards of Messrs. Denny Brothers, Dumbarton, Scotland.

ENGINEERING SPECIALTIES.

Portable Hydraulic Punch.

The accompanying cut illustrates a portable beam punch operated by hydraulic pressure which is found to be a most convenient tool in shipyards, as it is mounted on wheels and can be drawn to the work. The punch is operated by a pump worked by a lever inserted in the socket shown on the left side of the head. The parts are of easy access for examination and repair, and the head may be turned to receive the lever from any position, so that the operator may stand in any convenient place. The bed is of steel. One motion of the lever in the lower socket withdraws the punch entirely from the machine or brings the punch down on the



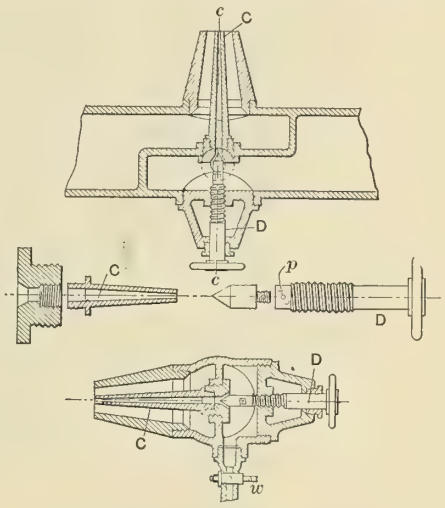
PORTABLE HYDRAULIC BEAM PUNCH.

work without the labor and the loss of time necessary to pump it down. As the punch is prevented from turning, irregular-shaped dies may be used without the danger of the punch cutting down on the die. The machine is made in two sizes, with a 9-inch and a 12 1-2-inch throat, and the design of the jaw permits a beam to be punched close to the flange. The tool may be lifted by the hand ring at the top. This machine is built by the Watson and Stillman Company, 204 East Forty-fifth street, New York, N. Y.

Liquid Fuel Burner.

The oil burner, of which the following is a description, claims as an improvement the method of fastening the parts subject to wear so that they may be easily removed. The illustration shows a horizontal sectional view at the top, a sectional view through line *cc* at the bottom, and detail views of the oil valve and nozzle. On the sectional views there are the valve, *D*, and the nozzle, *C*. The exterior nozzle is the steam or compressed-air nozzle, and it is screwed into the pressure pipe as shown. The oil nozzle is screwed into a hardened bushing, which is itself screwed into the partition which separates the oil and steam passages. This bushing is the part which is most apt to wear, and its method of fastening, as described above, is plainly seen from the drawings.

The back of this bushing also forms the conical seat for the needle valve, and the end of this valve is in the form of a removable conical plug, which can be fastened to the valve stem by screwing it in or holding it in with a pin, as shown at *p* in the enlarged view of the valve stem. It is thus seen that the two parts of the burner most liable to wear, namely, the valve seat and



NEW STYLE OF LIQUID-FUEL BURNER.

plug, are made and fastened in such a way as to be easily and cheaply renewed. A cock, *w*, placed as shown in the lower sectional view, allows the heavy impurities of the oil, which collect at this point when the burner is not in use, to be drained off before lighting.

The burner has a great variety of uses. Three burners will be equivalent to about 25 square feet of grate under a marine boiler. They may be attached to all kinds of furnaces for melting metals and are also used with good results on annealing furnaces, grate- and angle-bending furnaces, etc. The burner is portable and can be taken on board ship for use in repairing bent or fractured plates. It is also well adapted to rivet forges and for heating small and large billets used for drop forgings.

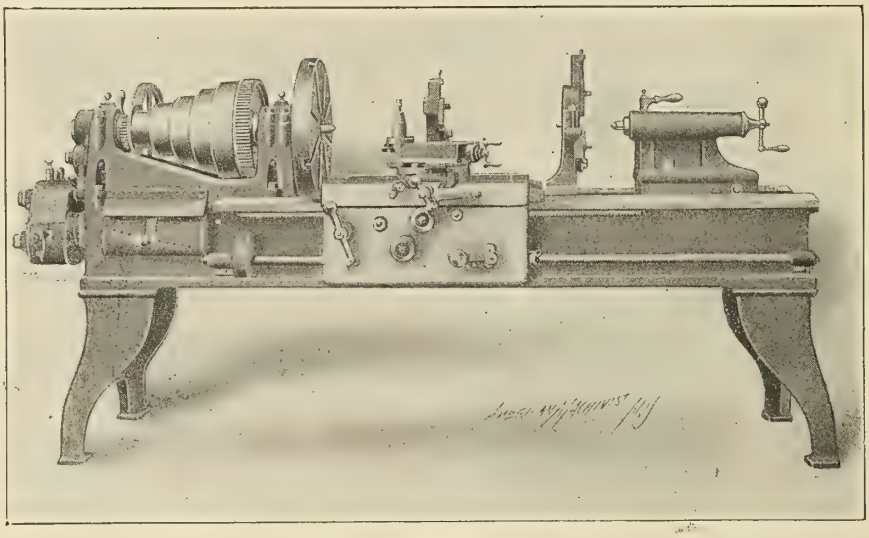
For further particulars concerning this patent burner address James Moran, 47 Horatio street, New York, N. Y.

Eighteen-inch Engine Lathe.

An 18-inch lathe has been put on the market by the American Tool Works Company, Cincinnati, Ohio, which embodies in its design the greatest producing capacity with the requisite quality of workmanship in the machine itself and accuracy of its product. This is considered by the makers to determine the true value of the lathe.

The lathe has a range of forty-four changes of thread and the same number of changes of feed, obtainable in about thirty seconds without removing a single gear. It

will withstand the heavy duty now imposed upon tools due to the introduction of tool steels adapted to high speeds. Gears have been made of steel wherever it has been found there is special wear, and all parts are made sufficiently strong to place the limit of the feed at the belt and not in the apron or gear box. The feeds are positive, and ratio between the longitudinal and transverse feeds is even. All jigged parts are interchangeable. The workmanship and finish are as good as obtainable with the best of tools, and every machine is tested before leaving the shop.



AN 18-INCH ENGINE LATHE.

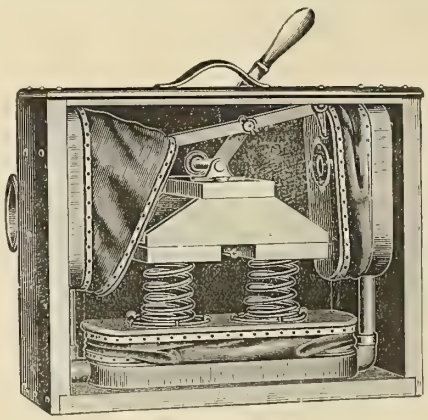
The bed is a box girder with a patent drop-V pattern, giving an additional swing of about 21-2 inches. The webs are tied together with girths of box form, making the bed very strong indeed. The head stock is massive and symmetrical, and the cone has five steps for the wide belt. In connection with the back gears ten changes of speed are available and arranged in geometrical progression. The spindle is of high carbon steel and the bearings of the best anti-friction metal, provided with ring oilers. The carriage is extremely heavy and substantial, provided with T-slots, and is gibbed to the bed for its entire length. The lead screw is located on the inside of the bed, and imparts the motion to the carriage directly under the cutting tool.

The apron is tongued and grooved to the carriage. The reverse of the feeds is not accomplished by means of double bevel gears, as in ordinary lathes, but by means of tumbler gears suitably controlled at front of apron. The screw-cutting feature of this lathe has many special points. All gears are cut from the solid and all shafts are made from high carbon steel. A full description of this lathe can be had by writing to the American Tool Works Company, Sixth street, Cincinnati, Ohio.

A Reed Fog Horn.

The fog horn here illustrated has a large sale in this country and abroad, as it embodies the two requirements of being well designed and well built. It is a reed horn and the operating mechanism is shown in the accompanying cut. There is no inside box to swell and shrink and allow the air to escape, and the valves, which are metal lined with soft leather, hang in an upright position, opening and shutting at the slightest movement of the lever, thus giving a swinging movement with a quick force of air to the horn instead of a rise and fall. No water is required inside the box to swell the wood and limber up the valves before using each time, as is required in other horns.

The horn is blown by moving the crank back and forth, when a large quantity of air is pressed into the chamber and with very little friction. The wear on the bearings and inside working parts is very small. The horn is protected by a galvanized sheet-iron covering



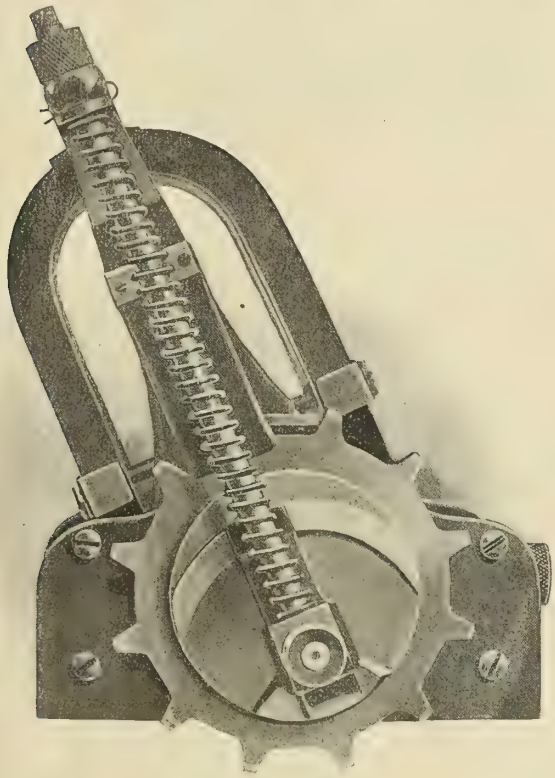
REED FOG HORN.

and placed under the lever. Among the features of construction should be noted the one-piece crank hanger, the turn-down handle having no nuts or pins to break loose, and the leather bellows, which is secured to the solid blocks of wood by being forced into the groove of the wood, held in place by a brass strip. All the bearings and metal parts are of hard brass, made strong enough to withstand many years of service. The manufacturer of this horn is L. D. Lothrop, 66 Duncan street, Gloucester, Mass.

A Novel Magneto.

The advantages and uncertainties in the use of electric batteries for ignition purposes in gas and gasoline engines are well understood by most users. To lessen the wear and tear on the battery the igniter has been applied, but even with this the battery is required for producing the spark upon starting the engine. It is to meet these requirements that the Goodson ignition device, made by the Goodson Electric Ignition Company, Providence, R. I., and which is here illustrated, has been devised and now placed on the market.

The igniter is an electric generator of the magneto type, provided with a spring-impelling device, connected to a crank on the armature, whereby the armature is made to rotate within the magnetic field for a portion of a revolution at a speed which is entirely independent of the speed of the engine, and which is sufficient to generate the required current to produce a good spark. It is connected directly to the engine shaft, either by sprocket wheels or by gear, and is so arranged that as the shaft turns it puts the spring-impelling device under tension, and is so timed with reference to the position of the piston that the device is tripped into action at the proper time, giving the armature a quick impulse and producing the spark. As the armature revolves only once for every spark made, if the engine be of the four-cycle single-cylinder type the magneto is geared to run only one-half as fast as the engine. If it be of the two-cycle single-cylinder type, then the igniter would be run at the same speed as the engine.



CONSTANT-SPEED MAGNETO.

The igniter is so constructed on a rocking base that the time of the ignition can be varied at will while the engine is in motion.

Briefly speaking, this igniting device is a simple alternating magneto, strongly built, and provided with a little spring attached to a crank on its armature shaft, which is put under tension and tripped into action by the engine, rotating the armature within the magnetic field, producing a single electric impulse and at the proper time to produce the spark. It may be rocked on its base to change the time of ignition at will. The advantages of this machine are, that no batteries or spark coils are required, the mechanism is very simple and armature and brushes are dust- and water-proof, the current is of high tension, the spark produced is of constant strength whatever the speed of the engine.

MUSHROOM ANCHOR WITH IMPROVED BULB SHANK.

Bulb-Shanked Mushroom Anchor.

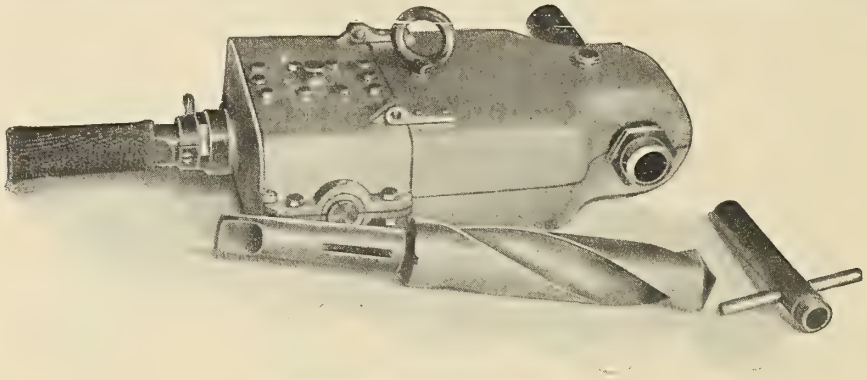
The mooring anchor, of which the mushroom is the most familiar shape, is a very modern form of shipholder; but in its way this latter type is as perfect an instrument as is its older brother of the stock and flukes. All seamen and yachtsmen know that there is nothing so conducive to peace of mind and quiet sleep when in port as the knowledge that their mooring tackle and ground are of the right kind, and, blow high or blow low, their vessel will remain safely riding in the position in which they placed her. This is peculiarly the case with yachts, as craft of this class spend more days at anchor than they do under sail. But to have this feeling that your ship is safe, she must ride to a mooring, and that mooring must be of such a weight and shape as you are sure will resist all strains of wind and tide. This office the mushroom anchor fills to perfection. It cannot foul the chain, it will not trip, and it seldom drags, and yet when you want it it can be lifted and taken ashore for safe-keeping during the winter months. For mooring purposes it is for this reason the best and cheapest of all mooring devices.

The advantages of this special type are, that the shank is long and heavy to prevent the anchor from taking upright position. The weight of the bulb will throw the anchor on its side and thus remove the danger of having an upright iron rod under the boat. The anchor is made by the Fairhaven Iron Company, Fairhaven, Mass., and in sizes varying from a few pounds in weight and a few inches across the mushroom to 8 feet across the dish and weighing 4 tons.

particulars may be obtained by writing the Helwig Manufacturing Company, St. Paul, Minn.

New Igniter.

The cut below represents the new Gray igniter which the Mianus Motor Works, Mianus, Conn., now uses on all its engines. The main feature of this type of igniter is its simplicity. The make-and-break lever is operated by one strong spiral spring. The spring gives the electrodes a positive contact and when released makes a quick break at any speed. Further, all wearing parts are much heavier than usual, which overcomes a frequent criticism that all gas-engine igniters are too light and frail. These parts are made of tool steel carefully hardened, insuring longest wear possible, and all parts are interchangeable.



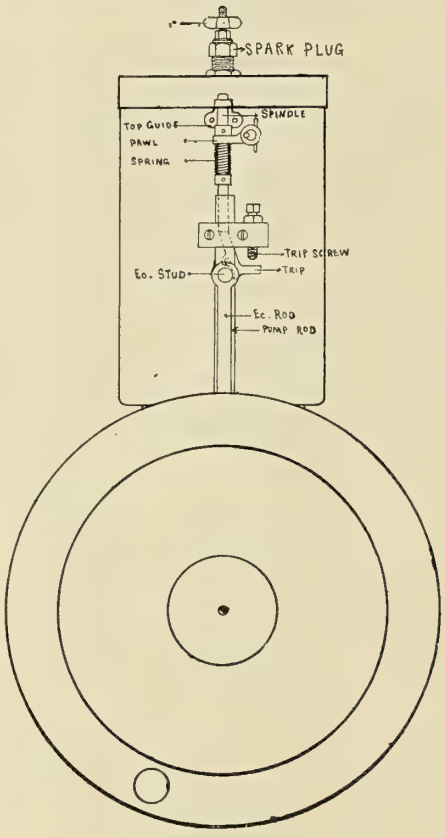
REVERSIBLE PNEUMATIC MOTOR.

Reversible Pneumatic Motor.

The above cut illustrates a reversible pneumatic motor in connection with means to rotate a spindle in which may be fitted different kinds of tools used in the construction of ships, boilers, bridges, engine and other machinery. It possesses many new features which render it very desirable by manufacturers of this class of work.

As will be seen, the spindle is through the extreme end, so it can be operated in very close quarters. The casing has a hinged lid, by raising which the machinery may be readily inspected, cleaned by air blast, and oiled. The motor has two oscillating cylinders, made of bronze brass, taking air at both ends, the admission and exhaust being controlled by the oscillation. The trunnions have steel ferrules to protect them from wear. In the main frame there are two air chests (one on each side), one for live air, the other for exhaust, and by turning handle half way around the functions of these chests become reversed, thereby reversing the motion and readily controlling the same. By a quarter turn of handle it stops. The air is admitted and exhausted through the handle, which also has an adjustable collar which can be set so that the motor runs but one way only. It has a detachable handle, which is used when the drill is suspended or when used for tapping and reaming.

The largest motor of this type at present built weighs 33 pounds and develops about 2 horse power under 90 pounds pressure, consuming about 17 cubic feet of free air per minute. The maximum speed of the drill spindle is about 200 revolutions per minute under 100 pounds pressure in this size. The speed can be controlled by the handle or throttle to suit requirements. This motor is not in an experimental stage, as it has been in actual service over four years. Among the uses of this end spindle motor may be mentioned drilling door sheets and the holes in flanges of I-beams by setting point of feed sleeve against one flange and the drill in the other, as it is very short from point of feed screw to end of socket. It has very few parts. Other



THE GRAY IGNITER.

QUERIES AND ANSWERS.

Q. 122.—Please answer the following questions:

(1).—What are the precautions taken to prevent scale deposits on the interior of boilers using salt water?

(2).—In using lake or river water in boilers what deposits are mostly to be feared, and what precautions are taken to guard against them?

(3).—If you use well water in a boiler that is hard by reason of carbonate of lime or magnesia, how can it be made soft?

A. C. F.

A.—(1) The primary precaution must always be to prevent as far as possible the entrance into the boiler of sea water with its scale-forming constituents. With the suitable provision of modern marine equipment for make-up feed, and, above all, with constant and painstaking care, this can be realized to such an extent as to reduce the inflow of sea water and the scale formed to very small proportions. The chief leakage will be in the condenser, from the salt-water to the fresh-water side, and only the greatest care will serve to keep the condenser tight and prevent such leakage. With such care, however, and other suitable precautions, the amount of scale formed is so small that often little or no additional precaution is taken, and the scale is simply removed from time to time as the periodical examinations of the boilers may indicate necessary.

It is possible, however, to take various steps which will modify to some extent the character of the scale produced by salt water, or reduce its amount. It should be noted that salt-water boiler scale is chiefly sulphate of lime, while fresh-water scale is chiefly carbonate of lime. The former is much the harder of the two, and is more difficult to remove from the heating surface of a boiler. Soda ash or other such alkali has sometimes been employed with a feed water containing sulphate of lime. Such substances act by converting the sulphate into the carbonate, and thus into a somewhat less objectionable form. Barium chloride has also been used, but is relatively expensive. It acts by producing barium sulphate and calcium chloride, neither of which produces a scale. The use of zinc in boilers is also believed to exercise a modifying or preventive influence on the formation of scale by the chemical reaction of the zinc chloride on the scale-forming salts. It must be realized first and last, however, that the great safeguard lies in keeping salt water out of the boiler; in using only fresh water to start with, and only condensed steam for feed, with an auxiliary supply from evaporator to make up for loss; and in a constant watch over the condenser tubes and packing. With these conditions fulfilled it is not too much to say that the old bugbear of scale in boilers is largely a thing of the past, and from one of the most serious has become one of the minor difficulties with which the marine engineer has to contend.

(2) The chief scale-forming constituent of fresh water is calcium carbonate, or carbonate of lime. This is insoluble in water, while the calcium bicarbonate is quite soluble. It is in the latter form that the substance exists in ordinary lake or river water. If now such water is heated to the boiling point the bicarbonate of lime is broken up, carbonic acid is driven off, and the insoluble carbonate is left. This separates out as a more or less powdery deposit, and if alone would not, as a rule, produce a very serious scale. Mixed with a little sulphate of lime, however, or if there should be any sulphuric acid present, or in certain other combinations, a more or less hard and closely-adherent scale is produced. Magnesium bicarbonate, which is also sometimes present in fresh water, is reduced in a similar manner by heat, and may take part in forming a scale.

If the proportion of such substances is small such scale will form very slowly, and often no special precautions are taken to prevent.

Occasional cleaning, as examination may dictate, will thus keep boilers in the desired condition of substantial freedom from any injurious deposit of scale. In some cases, however, the proportion of such substances is larger and active measures are required. Of these the most efficient and satisfactory is the use of some form of feed heater or purifier in which the water is brought to the boiling point and in which the scale is thrown down before it goes on to the boiler proper. The purifier or heater is so arranged as to admit of ready cleaning, and thus the boiler is protected.

A vast variety of substances have been recommended and are in use to prevent the formation of scale in a boiler when fed with fresh water containing the usual impurities of river or lake supply. Some of these substances act chemically, some mechanically, and some perhaps in both ways. From the great variety in the solid matter contained in ordinary fresh water it can hardly be expected that any one mode of treatment will be equally suitable for all cases.

One class of substances includes oak and hemlock bark, which contains tannic acid. This, however, may attack the boiler and cause serious corrosion. Other substances, like vinegar, cane juice, distillery slops, etc., many of which contain some acetic acid, have been used with success where no sulphates are present. The acetic acid is, however, liable to cause corrosion, and such substances can hardly be recommended. Sal-ammoniac may also be used, producing two substances: ammonium carbonate, which is volatile and passes off in the steam; and calcium chloride, which is soluble, but which would gradually accumulate in the boiler unless the contents were occasionally blown out.

Among the substances which act mechanically, crude petroleum or kerosene oils have been much used. It is supposed that they act by preventing close adherence between the particles of scale and the heating surfaces.

Where there is reason to expect in the bottom of the boiler the accumulation of powdery deposits, the bottom blow should be freely used to remove them and to prevent them hardening to scale.

As with salt water, the best safeguard against scale is to keep its constituents out of the boiler. If they enter in only small degree, then watchfulness and suitable cleaning, with perhaps the use of some form of compound found efficient and safe, will satisfactorily insure all interests involved.

(3) The answer to this is suggested by the discussion in (2). Bring it to the boiling point in a preheater and give it time to deposit its solids.

Q. 142 (1).—Will you kindly answer the following through your paper at your earliest opportunity: What are the advantages and disadvantages of the Stephenson link that is used on marine engines?

(2).—Which is the stronger, chain or zigzag riveting, and what is their proportional strength? F. G. S.

A.—(1) The Stephenson link valve gear has certain distinguishing features or characteristics, some of which may be viewed as advantages or as disadvantages, according to the special circumstances of the case.

Thus, structurally, the gear involves the use of two eccentrics for each cylinder, and the natural arrangement of the valve chests brings them directly over the eccentrics or in the fore-and-aft line of the cylinders. These arrangements naturally require a certain additional length of engine, due to valve chests and valve gear alone, and independent of other structural considerations. With the various types of radial valve gear the eccentrics are either reduced to one or are dispensed with entirely, and the valve chests, as a rule, are on the sides of the cylinders instead of between them. The Stephenson link gear requires, therefore, as a rule, a longer engine over all than the radial gear, and where the saving of length may be a very important item this feature must be counted as a disadvantage for the Stephenson gear. Actually, however, the difference is not great, as the shortening up of the engine will soon meet a limit in the necessary dimensions of the shaft, in order to provide the necessary lengths of crank pin, lengths of pillow-block bearing, thickness of crank web, etc., to say nothing of the diameters of the cylinders themselves.

On the other hand, compared with the radial gears in general, the Stephenson link consists of fewer parts, and is, on the whole, simpler mechanically. It is also usually considered to be, on the whole, rather less liable to break down than the radial gears, though with either this is merely a matter of good design. In particular the Stephenson link has fewer pin joints than most of the radial gears, and wear at the joints and moving parts does not produce so great a disturbance in the valve events and steam distribution as with the radial type of gear.

As regards the valve events and steam distribution, there is comparatively little difference between the two types of gear, in spite of the various claims made for the radial gears. With either the cut-off may be readily varied by linking up, and the engine may be reversed by an extension of the same operation. With the usual open-rod form of Stephenson link the lead increases as the gear is linked up and the cut-off made earlier. With the radial type of gear the lead under like conditions remains the same. This is a characteristic of the radial gear and under some circumstances may be considered an advantage, while the corresponding change of lead with the Stephenson link would be a disadvantage. Most engineers are agreed, however, that there is no marked advantage in the mere fact of constant lead as the gear is linked up, and are quite ready to accept the slight increase which is given by the Stephenson link. On the other hand, the decrease of valve travel and of port opening is less rapid, as the gear is linked up, with the Stephenson link than with the radial gears. In all such gears the port opening is cut down with earlier cut-off, but in the Stephenson link with open rods it is less pronounced than with the radial gears.

Considered either structurally or as a mechanism for operating the valves of a marine engine, the Stephenson link has more than held its own in competition with the various other types of gear, and to-day may be fairly considered as the typical or standard type of marine valve gear the world over.

(2) With riveted joints properly proportioned, there is little or no difference in the strengths or efficiencies of the two styles of riveting. Certain experiments have, however, indicated a slight margin in favor of chain riveting. The difference, however, is small at most, and in many experiments is more than masked by differences between individual joints of the same type. So far, however, as there seems to be a difference it is rather in favor of the chain-riveted joint. It is not possible, however, to state any relative strength; the difference is too uncertain and too slight. It should be understood that, quite independent of this question of relative strength, zigzag riveting is usually employed in all multiple-riveted joints which are required to be water- or steam-tight. The reason for this is readily seen to be in the fact that the zigzag distribution of rivets naturally gives a tighter joint than the chain distribution. On the other hand, where water- or steam-tightness is of no consequence, as in bridge or other structural work, chain riveting is often, or perhaps even commonly, employed.

Q. 144.—Will you please give me the rule to find the efficiency of coal; that is, if one kind is 1.1 per cent. and another is 1.2 per cent. Also the rule for displacement of ships.

A. J. S.

A.—There is no such thing as efficiency of coal, and we are at a loss to understand the first part of your question. Coal is composed of carbon and volatile matter, which in hard coal ranges about 84 per cent. of carbon and 3 or 4 per cent. of volatile matter, and in soft coal about 60 per cent. of carbon and 30 per cent. of volatile matter; the remaining percentage is made up of moisture, ash, etc. It is the burning of this carbon and volatile matter which produces heat. One pound of pure carbon burned to carbonic acid gives 14,600 British thermal units. This unit is used for measuring heat, and one unit being equivalent to the heat required to raise the temperature of one pound of water from 60 degrees temperature F. to 61 degrees. Good anthracite coal has a heating value of about 13,500 B. T. U., and the best qualities of bituminous coal range from 14,000 up.

There is always a certain amount of moisture in coal, which ranges from 1 to 6 or 7 per cent., and it may be that you have gotten this figure confused with the efficiency.

The rule for finding the displacement of a vessel is: First, to find the cubical contents in cubic feet and divide this by 35, which is the number of cubic feet in a ton. This is for salt water; if the vessel floats in fresh water divide by 36. The cubical capacity of the ship is found by multiplying the length between perpendiculars × the mean draft × a coefficient. This coefficient is known as the block coefficient, and varies from .45 or less for yachts to .86 for big freight steamers. This figure can only be obtained from the displacement calculations.

Q. 145.—As a constant reader of your paper I take the liberty to ask these questions regarding an experiment of mine:

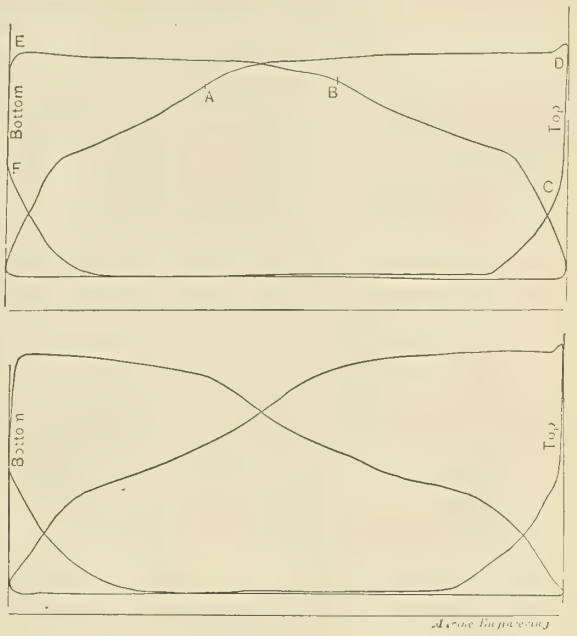
I have an iron lifeboat 22 feet 6 inches over all, 6 feet beam, and 32 inches deep amidships. I have tunneled the after air tank for shaft and contemplate trying to put power in the boat as follows: One boiler, built on the Salamandrine type, but with what I think an improvement of 65 square feet of heating surface with 3-4 inch steam outlet, burning kerosene oil as fuel, carrying 200 pounds pressure per square inch. One vertical com-

pound engine with slide valves, 3 1-2 by 6 by 4 inches stroke, with 14 square feet cooling surface in keel condenser. I anticipate using a 20-inch diameter propeller. What would be the most efficient, a three- or four-bladed propeller? What is the best pitch and blade area? And what speed could I expect to get out of a boat weighing about 2,000 pounds? W. M. M.

A.—Your question leaves a good deal to the imagination; that is, to be assumed before any results can be stated. Probably your mean draft with machinery installed will not be less than about 18 inches, which would correspond to a displacement of about 3.4 tons. Then if you are able to maintain 200 pounds of steam on your boiler and turn your engine up to about 400 revolutions per minute, you should realize a reduced mean effective pressure of perhaps 80 pounds and develop about 20 I. H. P. If such conditions could be maintained, then you might look for a speed of 9 or 10 miles per hour, provided your boat were not so bluff as to make such a speed entirely out of the question. To absorb this power and to develop any such speed, however, you need a propeller larger than 20 inches diameter. Computation shows that for 400 revolutions per minute the propeller under such circumstances should be about 26 inches diameter and 34 inches pitch. If you use a 20-inch propeller your engine, under the conditions assumed, would simply run away with it; you will get high revolutions and large slip, but will not realize the corresponding speed. If you must use a diameter of 20 inches, however, then use four blades with plenty of area, say 140 square inches, with a pitch of about 30 inches, and experiment with the engine till you get the best results practicable from the combination.

Q. 146.—Will you please give your opinion regarding these two sets of cards from the high-pressure cylinder of a compound engine? The stroke is 32 inches; steam pressure at engine 145 gage. The revolutions for set number 1 were 82, with cut-off at 20 inches; and for set number 2, 76 revolutions and cut-off at 16 inches. The clearance at top is 1-2 inch and at the bottom 5-8 inch. In particular I should like to know whether there is anything to show if the piston valve leaks. P. F. V.

A.—Taking card number 1 first, we can easily pick out the point of actual steam closure at about A for the downstroke and B for the upstroke. These figure out 66 per cent. for the downstroke and 59 per cent. for the upstroke, giving a mean of 62.5 per cent., which corresponds to the 20-inch cut-off. The initial pressure scaled from the cards is 134, which shows some considerable wire-drawing through the ports, and suggests that the ports are perhaps a trifle small. Again, looking carefully at the lead line on the two ends, the slant of the line *CD* is plainly seen, indicating a suitable lead on top. There is no such line at the other end, and the rounded corner at *E* indicates, with the shape of the line *FE*, that probably the lead at the bottom is very small, or, perhaps, nothing at all. It might help matters to lengthen the valve stem slightly, thereby increasing the lead on the bottom and decreasing it on top, though the card does not show any evidence that the lead on the top is too large. Any other adjustment, however, would involve changing the lap on the valve, and that would be hardly practicable, except with a general overhaul. So far as the other events on the card are concerned, release seems to occur at about 9 per cent. on top and 10 on the bottom, while compression begins at about 13.5 per cent. on top and 15.5 on the bottom. These are fair values and suggest nothing wrong with the exhaust side of the valve. So far as the card can be measured up and estimates made, there does not seem to be evidence of leakage past the valve, or, at least, if there is such leakage it is quite small.



Referring to set number 2, the cut-off is at about 55 per cent. on top and 45 on the bottom, a mean of 50 per cent., agreeing with the 16-inch cut-off. The release is at about 13 per cent. on top and 14.5 on the bottom, while the compression is at about 17.5 per cent. on top and 20.7 on the bottom. These various differences are all consistent and correspond to the gear in the linked-up position. The initial pressure scales a little higher, about 136 pounds, which may be due to the lower revolutions and decreased wire-drawing. The difference in the lead at top and bottom is still seen, and is the chief point which seems to call for adjustment.

On the whole, the cards are well formed and indicate quite as satisfactory a balancing of the various events, etc., as is commonly found.

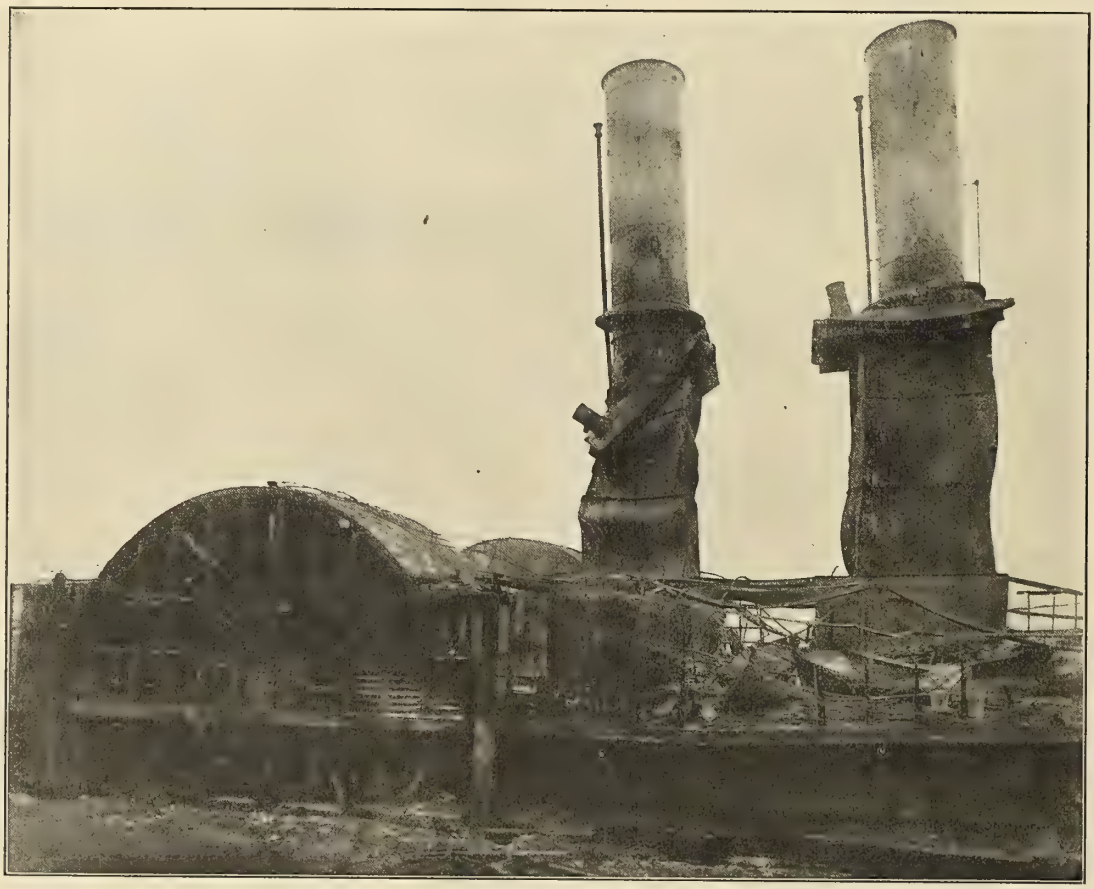
Q. 147.—I am a constant reader of your magazine and hope to be a marine engineer myself some day, and so would beg leave to ask if you would publish in the next number of Marine Engineering some of the most difficult and important questions regarding marine boilers and engines that a person should be able to answer to obtain a first-assistant engineer's license of a vessel of about 1,500 tons. Also, are there any special questions asked by the examiners regarding electricity? C. H.

A.—Space does not permit us to give all the important points about which an applicant should be conversant in order to pass the examination for assistant engineer. We presume that you are at present working in the engine room of a ship, as this is a necessary qualification for taking examination, and suggest that you first get a copy of the rules issued by the United States Steamboat Inspection Service, Department of Commerce, Washington, D. C., and also that you purchase some of the books on marine engineering. *Practical Marine Engineering*, by Professor W. F. Durand, is most eminently suited for your purpose; also might be mentioned Lucas' *Questions and Answers*.

Burning of the New Steamer Montreal.

A most spectacular fire took place in the St. Lawrence river off Montreal on Saturday night, March 7. In the early evening the new steamboat *Montreal*, of the Richelieu and Ontario Navigation Company, caught fire and the upper works were entirely destroyed. The vessel was nearing completion and was about to be delivered to the owners. She was moored in the river near the Allan line pier, but the fire department of the city was entirely unable to check the flames, and only with difficulty prevented the spreading of the fire to the adjoining property. The *Montreal* was launched from Bertram's shipyard, Toronto, in 1900, and brought down through the rapids to Montreal, where the joiner work was completed and the vessel equipped. The hull was of steel, but above the main deck all was of wood. The painters had been at work on the vessel, and it is presumed that the fire broke out among the cans of paint stored on board; at any rate, within a short time from the sounding of the alarm the entire ship was a sheet of flame.

Thousands of people came down to the river front to witness the fire, and many climbed on the rafters and beams of a new freight shed being erected on the wharf. Suddenly this framing gave way and the roof fell down, injuring scores of people. The *Montreal* was to be used in the summer night service between Montreal and Quebec and to replace the steamer of a similar name running on this line. She was 340 feet length over all and was propelled by a compound inclined engine with feathering paddle wheels. At the time of going to press, it is not known how much of the hull and machinery may be saved. Three hundred and fifty thousand dollars had been paid by the Richelieu and Ontario Company to the builders on the contract price of $500,000 The loss is covered by insurance.



NEW STEAMER MONTREAL, BURNED TO THE WATER'S EDGE AT MONTREAL, MARCH 7, 1903.

PERSONALS.

N. W. Akimoff has left the hull department, drafting room, of the New York Shipbuilding Company to take a position in the engineering department of the Marine Engine and Machine Company, of Harrison, N. J.

William N. Finkenaur is now employed as a fitter at Townsend-Downey Shipbuilding Company, Mariner Harbor, New York. He was formerly a draftsman in the electrical department at the Cramp yard.

Edson F. Gallaudett, formerly of the Cramp company, has accepted a position with the New York Cash Register Company, Dayton, Ohio.

William F. Norton has gone with the Manitowoc Dry-Dock Company, Manitowoc, Wis., as general draftsman. His former position was as steamfitter of the Chicago Shipbuilding Company.

George C. Cook has removed to 130 Water street, New York, and besides his former business as naval architect. he is now conducting a brokerage business.

F. H. Hibbs, formerly naval constructor, for three years stationed at the Puget Sound Navy Yard, has resigned from the service and will enter the employ of Moran Bros. Company, Seattle, Wash.

Clifford Lee, Jr., who was formerly draftsman of the Crescent shipyard, Elizabeth, N. J., has taken a position as draftsman with the American Locomotive Company, Richmond Works, Richmond, Va.

Jargen Rasch has gone with the Westinghouse Machine Company, East Pittsburg, to work in the designing department.

Perry K. Thurston has left the drafting room of the Neafie and Levy Ship and Engine Building Company to accept a position as draftsman with the Bureau of Steam Engineering at Washington, D. C.

Arent Arneson, who formerly had a position in the drafting room of William R. Trigg Company, has accepted a position with the American Locomotive Works at Schenectady, N. Y.

H. S. Webster, formerly of the hull department of the Bath Iron Works, has accepted a position with the New York Shipbuilding Company in the hull drafting room.

Chas. C. Turner, formerly of the Bath Iron Works and Thomas Lawley and Son, has accepted a position with the Fore River Ship and Engine Company.

John L. Denny, formerly connected with Denny Bros., Scotland, and with the Bath Iron Works, Bath, Me., has accepted a position with the Fore River Ship and Engine Company in the hull drawing office.

John A. Price, who held a position as draftsman with the Bath Iron Works, has taken a position in the drafting rooms of the New York Shipbuilding Company.

Chas. Brown has severed his connection with the Hyde Windlass Company, Bath, Me., where he has been employed for a number of years in the counting rooms.

E. S. Farwell, formerly connected with the International Power Company as expert steam engineer, has opened offices as consulting engineer at 309 Broadway, New York, N. Y.

C. M. Andrews, who was formerly in the drafting room of the Wm. R. Trigg Company, has gone to the New York Shipbuilding Company, where he has taken a position as draftsman.

At the meeting of the stockholders of the Newport News Shipbuilding and Dry-Dock Company, held at Newport News, Va., on March 13, the old directors were re-elected, and Calvin B. Orcott, of New York, was re-elected president of the company. Mr. Orcott has been president since the establishment of the yards.

A New Submarine Boat.—The submarine torpedo boat *Protector*, built by Simon Lake, Bridgeport, Conn., is being prepared at City Island, N. Y., for a series of trials that are soon to be held to test her capabilities. The *Protector* is 60 feet in length, 11 feet wide, and 12 feet deep.

Steamer City of Macon.—The Savannah Line steamer *City of Macon*, for the New York and Savannah passenger and freight service, was launched from the Delaware Shipbuilding and Engine Works, Chester, Pa., March 14. The vessel is 400 feet long, 50 feet beam, and will carry 14,000 bales of cotton besides perishable fruits.

TECHNICAL PUBLICATIONS.

Elements of Steam Engineering. By H. W. Spangler, Arthur M. Greene, Jr., and S. M. Marshall. Size 6 by 9 inches. Pp. 275. Price $3.00. John Wiley and Sons, New York, N. Y.

The purpose of this book is to instruct beginners in the different forms of steam apparatus and power plants and to explain briefly the construction and reasons for using the various parts. It is divided into nine chapters, dealing with boilers and auxiliaries, the steam engine, valve gears and diagrams, the uses of governors and valves, and the principles of condensers and multiple expansion. As the word implies, the book is most elementary and begins with describing the methods of generating heat and different types of boilers. Necessarily such a volume will be a description of specialties made by different manufacturers. The subject of boiler details is touched upon, such items as grates, stokers, furnace doors, dampers, pipe fittings, valves, riveting and staying, being treated in a general way and well illustrated. Under the head of Boiler Room Auxiliaries are described steam pumps, feed heaters, stacks, and forced and induced draft, also methods of conveying coal and ashes about a steam plant. The different parts of an engine are then taken up and their functions stated in simple language. Excellent detail drawings are given of the different types of connecting rods, crossheads, pistons, etc., for stationary, locomotive, and marine practice. The attempt has been made to cover the entire field in a cursory manner by the use of many illustrations. The province of the steam valve is then taken up, and the method of drawing a valve diagram is given. The different forms of valve gears are illustrated, and then follows the chapter on Indicating and Governing, containing the usual information on the methods of applying the indicator and reading and calculating the cards. In the last chapter the vacuum produced by condensed steam is explained, and then follow a few pages and illustrations of the different types of multiple-expansion engines.

Throughout the book the purpose of the authors has been to give to the student a working vocabulary, as well as an understanding of the steam engine, and the name of each part of any design is set in heavy type. As an elementary book it will doubtless take its place in the library of the steam engine.

Supplement United States Standard Registry of Shipping, 1903. Size 10 1-2 by 9 inches. Pp. 20. United States Standard Registry of Shipping, 18 Exchange Place, New York, N. Y.

This supplement is written especially to meet the demand for rules covering the construction of vessels carrying oil in cargo. Until recently shipbuilders have had to carry on the oil-tank work without the guidance of special rules, as this form of construction is comparatively novel, and not sufficient information was at hand from which to draw up rules. The rules in the new supplement are to be used in addition to those of the main volume published a few months ago. The general requirements for the form of construction are briefly stated, among which might be mentioned that the cargo shall be carried to the shell plating and that a continuous oil-tight longitudinal bulkhead be fitted; that the thwartship bulkheads shall not be over 30 feet apart and

no oil shall be carried at the bow and stern of the vessel; that each compartment must have its own extension trunkway; that a cofferdam shall be fitted at each end of cargo spaces and no oil shall be carried in cofferdam. Rules for the structure of the ship are mostly similar to those for ordinary service, but special attention is paid to bulkheads, cofferdams, extension trunks, tunnels, and riveting. As the ventilation of oil-carrying spaces is absolutely essential to prevent explosion, this subject is well covered by the rules.

It is recommended that machinery and boilers be placed aft the cargo space and that no oil pipes, other than those used for bunker oil, are to pass through the boiler or engine spaces. The question of pumping cargo oil is taken up and pumps of ample capacity prescribed. Where oil is used under the boilers it must not have a flash point less than 150 degrees Fahrenheit. All lighting, except the running lights, must be by electricity on oil carriers. Taken as a whole the supplement will cover the construction of oil-tank vessels, and, while laying down few definite rules, the recommendations will be found most useful.

Turning and Boring Tapers, 1902. By Fred. H. Colvin. Size 5 1-2 by 8 1-4 inches. Pp. 24, with 21 illustrations and tables. Price 25 cents. The Derby-Collard Company, 256 Broadway, New York, N. Y.

This is the first of a series of practical papers to be devoted to the methods of turning and boring the usual form of tapers. The subject is treated in an eminently practical style, such that the little book will be of value to all machinists who wish to post themselves on ordinary forms of turning and boring tapers. The proper way of setting the lathe and the method of calculating the angle are clearly given, and then are described the method of cutting tapers with a combined rest and boring tapers and cutting tapered threads. The pamphlet is written in a direct and clear manner and well illustrated.

Injectors, Their Construction, Care, and Management. By Frederic Keppy, M.E. Size 6 by 9 inches. Pp. 70, with 45 figures. Price 25 cents. The Marine Industrial Publishing Company, Bridgeport, Conn.

It is safe to say that but comparatively few engineers understand the theory of the injector, which has now been in use in this country over forty years. The author in this little treatise gives an interesting historical sketch of the first injector, which, by the way, is practically identical to the modern types, and then states the conditions on which the operation of the injector depends. There are very many kinds of injectors, single tubes, double tubes, adjustable tubes, each of which has its special service. The different kinds on the market are described in a well-illustrated chapter. The use of a siphon or ejector is briefly considered, and the closing chapters are devoted to the care and use of injectors and the causes of their failure to act. This is a handy little book for any engineer's desk or engine room.

Technolexicon.—It is a well-known fact that a technical dictionary, comprising a complete vocabulary of terms of all the industries and their many branches, has been missing heretofore. Being aware of this fact, and of the great difficulty of such a task, the Society of German Engineers, in co-operation with other technical and industrial societies, domestic and abroad, are to publish a dictionary, called the *Technolexicon*, in the three mostly-used languages, English, French, and German.

This comprehensive work was inaugurated in March, 1901, by a publication which appeared in the paper of the Society of German Engineers, and, shortly after that, notices were sent to technical societies and individuals in Germany and abroad, stating the manner and ways in which contributions to the *Technolexicon* could be furnished. An idea of the comprehensiveness of the work can be obtained from the statement of Dr. Hubert Jansen, the editor in charge of the undertaking, whose name has already become connected with other encyclopædic works, in which he states that though words have already been gathered for one and a half years by societies and individuals in Germany, Belgium, France, England, and the United States, the collection will probably not be completed before the end of the year 1904 and the manuscript will be ready about the end of the year 1906.

Not only contributions of technical terms with the translations are valued, but also such contributions which, in giving merely the technical term, give, at the same time, an explanation thereof; also contributions regarding the customary phrases of the country in which they are used are highly appreciated. If terms are given which are very uncommon, it is desired that the source be given where the term may be found.

Besides this principal source of contribution it is found that catalogues, price lists, etc., of industrial firms, from which technical terms can be gathered, are of value, and it is desired, therefore, that all the manufacturing firms publishing printed catalogues, price lists, etc., send a copy of same to the Editor of *Technolexicon*, Dr. Hubert Jansen, Berlin, N. W. (7), Dorotheenstrasse 49. This is thought to be of interest to such firms, as the book will undoubtedly prove of valuable assistance in the work of translating catalogues from one language into another. All those who may desire to contribute through collecting terms and phrases, may apply for note books, especially arranged for that purpose, and for letters of information, directly to the editor, or to Dr. Alfred Mueller, 150 Nassau street, New York, N. Y.

New Trial Trip of H. M. S. Good Hope.

An interesting detailed description of the recent voyage of H. M. S. *Good Hope*, from England to Cape Colony, has been given in *London Engineering*. The voyage was of general interest, due to the fact that the ship carried Mr. Chamberlain to South Africa, but the voyage was of special engineering interest in that the *Good Hope* had but recently completed her contractor's trials and had not been tested for a long run.

The *Good Hope* is an armored cruiser of the following dimensions: Length over all, 500 feet; beam, 71 feet; draft, 26 feet; displacement, 14,100 tons. The machinery consists of two sets of 4-cylinder triple-expansion engines balanced on the Yarrow-Schlick-Tweedy system, the low-pressure cylinders being at either end. The cylinder diameters are 43 1-2, 71, 81 1-2, 81 1-2 inches, and the stroke is 48 inches; total cooling surface in both condensers, 32,000 square feet. The boiler equipment comprises 43 Belleville boilers with 382 elements in all, the total heating surface being 71,964 square feet, and the grate surface 2,314 square feet. The total weight of

machinery complete, including water in the boilers, is 2,540 tons. On the official trials a speed of 23.05 knots was maintained, with the engines indicating 31,088 horse power on a consumption of 1.92 pounds of coal per I. H. P.

Her engine-room complement during the official trials was 438, while on this trip there were but 292 men in the engineer's department. The ship was ordered to speed at 17 knots. From Portsmouth to Durban, besides the 150 tons of fresh water normally carried, a further supply of 279 tons was taken in the double bottoms, to be used if the evaporators were not sufficient to make up the lost steam. The start was made on the afternoon of November 25, with 27 of the 43 Belleville boilers under steam, the engines running at 85 revolutions, corresponding to a speed slightly over 17 knots. Much rough weather was experienced. The starboard intermediate crank pin became so heated on the 30th that the starboard engine was shut down, the brasses replaced, and the crank pin smoothed, filed, and rubbed over. On December 3 the ship entered the Suez Canal, having completed the run of 3,100 miles in 189 hours. December 5 and 8 were spent in overhauling machinery and taking on board 2,000 tons of coal.

The *Good Hope* sailed on the morning of the 8th for Zanzibar, a distance of 2,850 miles, completing the run in 170 1-2 hours at a speed of 16.7 knots. The heat of the Red Sea was greatly felt in the boiler rooms. On the 13th the bilge suction in the starboard engine room became choked, which caused the crank pits to fill with water. This washed out the oil from the starboard intermediate-pressure crank-head brasses, causing them to heat up, and the engine had to be eased off for cooling down. On the 15th Mr. and Mrs. Chamberlain were landed at Mombasa, near Zanzibar, and did not re-embark for Durban until December 21, during which period the ship was again coaled and opportunity given the engine-room force to re-examine and overhaul the starboard intermediate bearing and to adjust other bearings where necessary. Small defects in auxiliary and other engines were also rectified. As Mr. Chamberlain was not expected to arrive at Durban until the morning of the 26th, this last run of 1,600 miles was made in 15 knots.

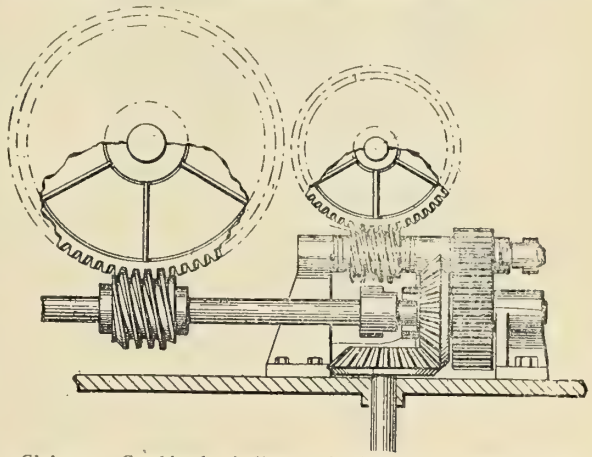
The boilers throughout the trip worked excellently. The plan for running them was to keep 27 of the 43 boilers under steam, cutting out 16 of those which had been running each morning and lighting the fires under 16 fresh boilers. A staff of men in the daytime made any necessary repairs of the boilers out of commission, cleaning and swabbing them, etc. Taking into account the fact that during the greater part of the voyage 45 auxiliary engines were almost continuously in use in addition to the main engines, the coal consumption of 2.66 pounds per indicated horse power for all purposes is fair. The indicated horse power for the run from Portsmouth to Port Said averaged about 10,300; from Suez to Zanzibar about 8,500; from Zanzibar to Durban 6,300. No measurement of the water evaporated was kept, but the ship's evaporators, working on the "closed exhaust," supplied sufficient water for drinking purposes and to make up the boiler loss; the extra 279 tons of fresh water taken in double bottoms at Portsmouth were not used.

On the first and second runs about 65 deckhands were used in trimming and stoking, and on the last run about 19 deckhands were used as stokers.

SELECTED MARINE PATENTS.

720,137. MEANS FOR RAISING SUNKEN LOGS. BERT H. HARRIS, REED CITY, MICH. Eight claims.

720,197. COMBINED WINDLASS AND WINCH. HENRY D. VAN DOORN, PROVIDENCE, R. I., ASSIGNOR TO AMERICAN SHIP WINDLASS COMPANY, PROVIDENCE, R. I., A CORPORATION OF RHODE ISLAND.



Claim.—1. Combined windlass and winch or warping mechanism whose respective shafts are geared up to separate shafts, adapted to be differentially geared together, and to the driving shaft, substantially as set forth. Ten claims.

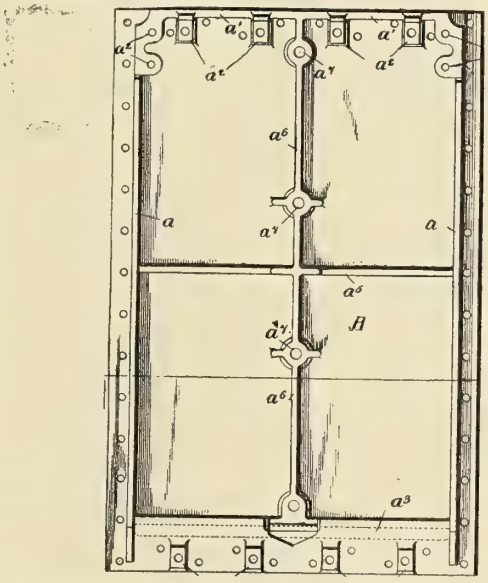
720,216. HATCHWAY GATE. JOHN BAYER AND HERBERT W. WIGAN, NEW YORK, N. Y. Nine claims.

720,557. MECHANISM FOR UNLOADING VEHICLES, ETC. VICTOR R. BROWNING, CLEVELAND, OHIO.

Claim.—1. In an unloading mechanism for vehicles, a cradle having buffers and a tilting platform for the vehicle mounted in said cradle in such a manner that when the cradle is moved toward the unloading position, the platform will be automatically tilted with reference to the cradle toward the said buffers. Eight claims.

720,897. MOTOR POWER FOR BOATS. FRED. A. CREED, WHATCOM, WASH. Two claims.

721,024. BULKHEAD DOOR. WILLIAM B. COWLES, CLEVELAND, OHIO, ASSIGNOR TO "LONG ARM" SYSTEM COMPANY, CLEVELAND, OHIO, A CORPORATION OF WEST VIRGINIA.

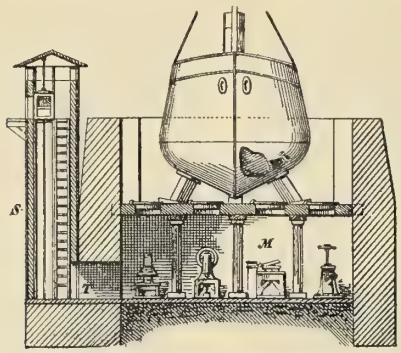


Claim.—1. As an article of manufacture, a lightweight bulkhead door, consisting of a single piece of cast metal having one of its faces plane and the other face provided with strengthening and retaining ribs, said door being made by casting a blank of about twice the required thickness and planing off one face thereof until the door is reduced to the required thickness.

721,012. MARINE-ENGINE GOVERNOR. EDWARD C. BUCK, PRETORIA, TRANSVAAL, SOUTH AFRICA.

Claim.—1. In apparatus for controlling the supply of steam to marine engines, the combination with a pendulum of a toothed quadrant fixed to a frame integral or fixed to said pendulum and situated above the point of suspension of the pendulum, a valve chest in the main steam pipe near to the steam generator, a pair of steam ports in said valve chest, a pair of slide valves adapted to cover or close said ports, a spindle formed with right- and left-hand threads engaging nuts upon the back of said slide valves, and a pinion upon said spindle engaging said toothed quadrant and adapted to be rotated thereby. Two claims.

721,222. DRY-DOCK. JOHN F. O'ROURKE, NEW YORK, N. Y.

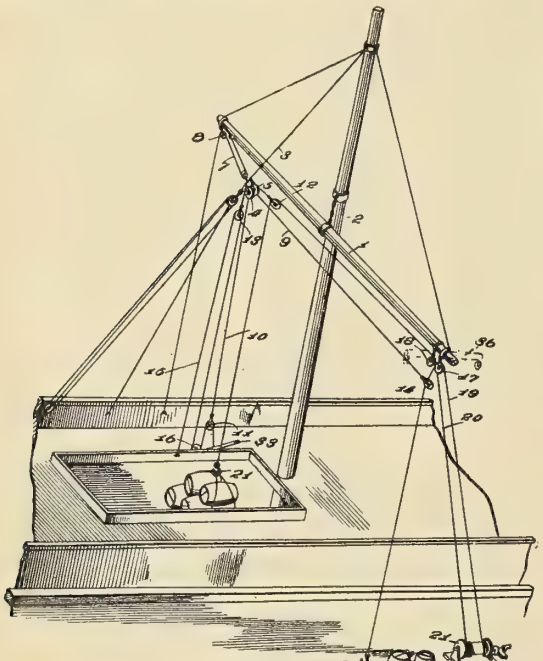


Claim.—3. The combination in a dry-dock of a chamber or room below the resting place provided for the vessel, communicating doors connecting the chamber with the dry-dock, and an entrance to the chamber from the outside. Three claims.

721,223. DRY-DOCK. JOHN F. O'ROURKE, NEW YORK, N. Y.

Claim.—2. The combination in a dry-dock of one or more chambers connected therewith by a door or opening in the wall thereof, closed by water-tight gates and having communication with the surface of the ground in which the dock is situated. Two claims.

721,067. HOIST. WILLIAM L. McCABE, SEATTLE, WASH.

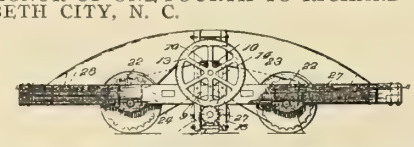


Claim.—1. In a hoist, the combination with a suitable yard and a suitable stay, of a block carried by said yard, a block carried by said stay, a cable passed through the block of said stay and carrying a block at each end, a cable passed through the block of said yard and one of the blocks of said cable, means for moving said last-mentioned cable longitudinally, a cable passed through the other block of the first-mentioned cable, and means for locking the same against movement. Eight claims.

721,286. SAIL. JOEL COUCH, CLAYTON, N. Y.

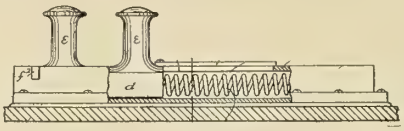
Claim.—1. A sail made of a series of sections, each of which has a free baggy edge intersecting pockets to which the fixed edges of the sections are connected, a rotatable mast, a boom to which said sail sections are connected, and which boom is mounted to move with the mast. One claim.

721,347. DEVICE FOR CLEANING THE BOTTOMS OF VESSELS. EDWARD S. WILLEY, ELIZABETH CITY, N. C., ASSIGNOR OF ONE-FOURTH TO RICHARD O. CRISP, ELIZABETH CITY, N. C.



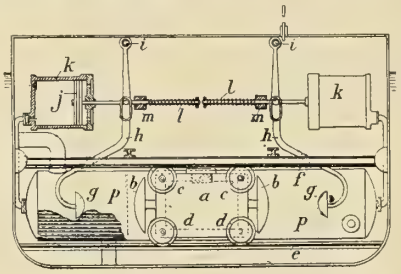
Claim.—1. In a device for cleaning the hull of a vessel, the combination with a suitable frame carrying gripping rollers, of vertical journal-box frames provided with spring-pressed slidable journal boxes, a cutter mounted in the lower journal boxes, provided with a gear wheel, a main shaft mounted in the upper journal boxes, provided with a gear wheel meshing with the cutter gear wheel, and means connecting the gripping rollers with the main shaft, whereby when said device is moved back and forth rotary motion is imparted to said main shaft and thereby to the cutter. Four claims.

721,465. HAWSER ATTACHMENT FOR VESSELS. RICHARD C. REAVLEY, PENARTH, ENGLAND.



Claim.—1. A cable or hawser attachment for vessels, comprising an elongated keeper adapted to be secured to the deck of a vessel or other support and having a longitudinal opening in the top thereof, a slide mounted in said keeper and provided with bitts which pass upwardly through said opening, a spring placed in said keeper and between one end thereof and the slide, and a cover plate secured to the slide and adapted to partially close the opening in the top of the keeper and protect said spring, said keeper being also provided at one side of the slot or opening in the top thereof with a scale, and said slide being provided with a pointer which operates in connection with said scale. Two claims.

721,501. WAVE OR TIDE MOTOR. CHARLES CAILLE, LE PERREUX, FRANCE.



Claim.—1 In an apparatus of the class described, the combination with the boat, of a weight adapted to be moved by gravity from one side of the boat to the other, an air compressor, and a lever adapted to receive the impact of said weight and impart the force thereof to the piston of said air compressor, substantially as described. Four claims.

721,663. SHIP'S ANCHOR. HENRY J. BROOKE, SVENDBORG, DENMARK.

Claim.—1. In an anchor, a shank having a spirally-disposed guideway upon its lower end and a pair of arms rigidly secured to the end of the shank in combination with a pair of movable arms having an aperture adapted to loosely receive said shank and move upon said guideway, whereby when both pairs of arms are in contact with each other they will be disposed at right angles, and when said movable arms are moved up the shank in said guideway they will be turned by said guideway and disposed substantially parallel with the fixed arms. Two claims.

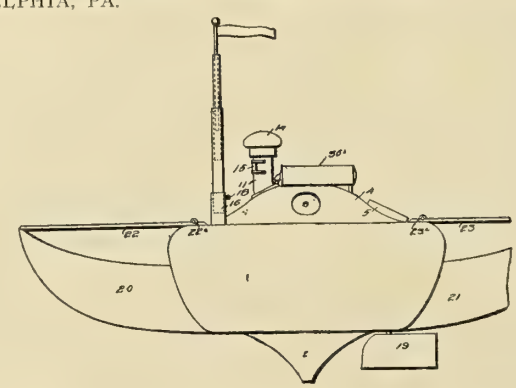
721,677. GROUNDING PREVENTER FOR MARINE VESSELS. CHARLES DORNFELD, NEW YORK, N. Y. Two claims.

721,868. BOAT. CLEMENS DROHOVITH, WEST SUPERIOR, WIS. Two claims.

721,851. APPARATUS FOR EXTRICATING STRANDED VESSELS. JOHN ARBUCKLE, BROOKLYN, N. Y.

Claim.—2. An apparatus for extricating a stranded vessel, comprising in combination a device for loosening the mud, means for guiding said device alongside the hull of the vessel, and means for removing the loosened mud from the hull of the vessel. Seventeen claims.

721,600. LIFEBOAT. ROLLAND FORREST, PHILADELPHIA, PA.



Claim.—2. In a life-saving apparatus, an enclosed vessel, an inflatable envelope disposed exteriorly of said vessel, inflatable extensions disposed on diametrically opposite sides of said vessel extending it longitudinally. Seven claims.